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Dräger medical
A Dräger and Siemens Company

Technical Service Manual
Part No. 4114108 Rev. K

Narkomed M Anesthesia System
Part No. 4114179

Draeger Medical, Inc.
Technical Service Department
3122 Commerce Drive
Telford, PA 18969

4 May 2004
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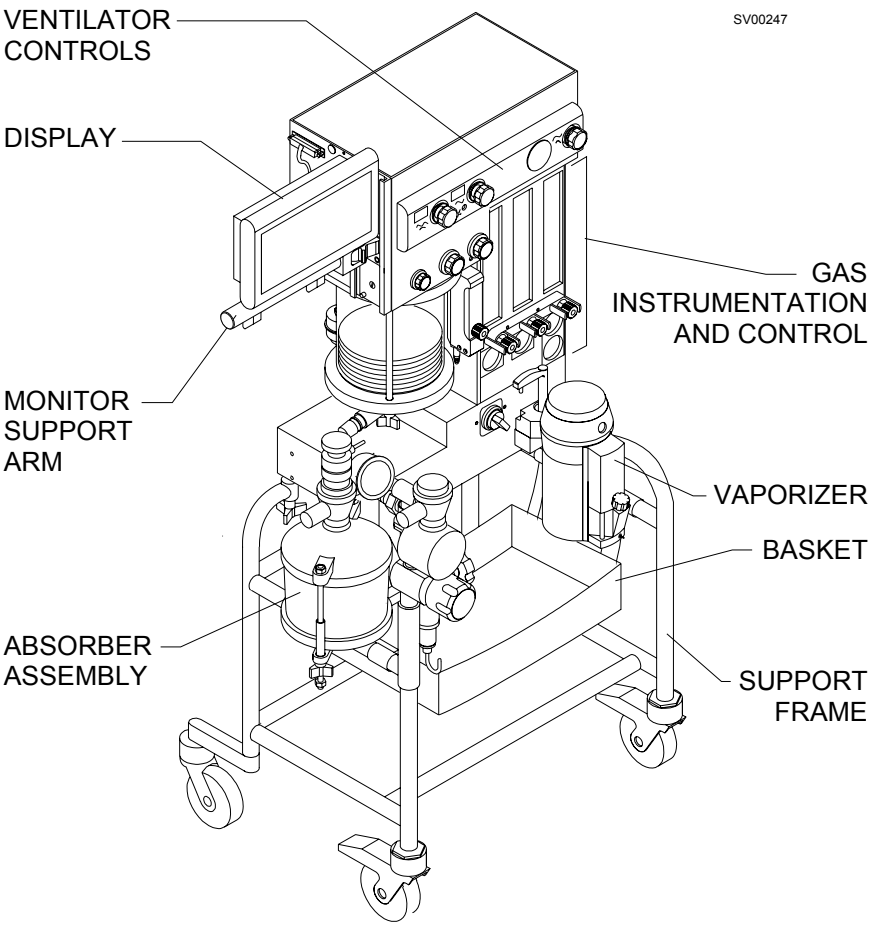
SV00247
VENTILATOR CONTROLS
DISPLAY
GAS INSTRUMENTATION AND CONTROL
MONITOR SUPPORT ARM
VAPORIZER
BASKET
ABSORBER ASSEMBLY
SUPPORT FRAME

General Safety Precautions

The following are general safety precautions that apply during servicing of the equipment covered by this manual. These precautions are repeated elsewhere in this manual where needed.

WARNINGS indicate conditions or practices which if not strictly observed could result in personal injury.

CAUTIONS indicate conditions or practices which if not strictly observed or remedied could result in damage to the equipment.

WARNING: Ensure that AC power is removed from the machine before removing the power supply. Failure to observe this precaution may cause injury by electric shock.

WARNING: Possible explosive hazard if used in the presence of flammable anesthetics.

CAUTION: The flow tube must be properly centered over the guide rings or damage to the flow tube may occur.

CAUTION: Do not over-tighten the retainer. Over-tightening the retainer may break the flowmeter tube.

CAUTION: The controller circuit board contains static sensitive devices. Use ESD protection when handling the controller assembly. Static discharge can damage components on the circuit board.

CAUTION: The processor board contains static sensitive devices. Use ESD protection when handling the processor assembly. Static discharge can damage components on the circuit board.

CAUTION: Do not twist the body of the Spiromed sensor when loosening the retaining nut. Hold the sensor while loosening the retaining nut to prevent damage to the sensor.

CAUTION: Use only Sensor Lubrication Kit P/N 2218180 for the Spiromed sensor. Substituting another lubricant could damage the sensor.

CAUTION: Observe wiring colors and polarity markings to ensure that the battery is connected correctly. Connecting the battery with reversed polarity may damage the circuitry.

CAUTION: Always operate machine on level surface. Before moving the machine, remove vaporizer, remove items from top shelf and display arm, secure absorber against left side of machine.

1.0 Introduction

1.1 Purpose

This manual provides the information needed to field service and maintain the Narkomed M anesthesia system. The DIAGNOSTICS section describes self-test and service diagnostics for checking the system functions. An understanding of the on-board service capabilities is necessary before any attempt is made to troubleshoot the unit. The TROUBLESHOOTING section shows the electrical distribution scheme and provides troubleshooting guides to assist the TSR in locating the source of a problem. The REPLACEMENT PROCEDURES section contains instructions for removal and replacement of the assemblies that are considered field-replaceable. The ADJUSTMENT AND CALIBRATION PROCEDURES section contains the field procedures needed to restore original system specifications. The Periodic Manufacturer's Certification(PMC) PROCEDURE section outlines the steps required to verify the electrical, mechanical and pneumatic safety of the unit and also identifies components requiring periodic replacement.

1.2 Recommendations

Because of the sophisticated nature of Draeger Medical, Inc. anesthesia equipment and its critical importance in the operating room setting, it is highly recommended that only appropriately trained and experienced professionals be permitted to service and maintain this equipment. Contact DrägerService® at (800) 543-5047 for service of this equipment.

Draeger Medical, Inc. also recommends that its anesthesia equipment be serviced at three-month intervals. Periodic Manufacturer's Service Agreements are available for equipment manufactured by Draeger Medical, Inc.. For further information concerning these agreements, please contact us at (800) 543-5047.

Draeger Medical, Inc. products/material in need of factory repair shall be sent to:

DrägerService
3124 Commerce Drive
Telford, PA 18969
(Include RMA Number)

1.3 General Troubleshooting Guidelines

Troubleshooting the Narkomed M should always begin by communicating with those who observed or experienced a problem with the unit. This may eliminate unnecessary troubleshooting steps. Once a general problem is identified, refer to the troubleshooting flow charts in Section 3 to determine the proper corrective action to be taken.

After a component has been replaced, verify that the unit is operating properly by running the appropriate diagnostic procedure. The PMS PROCEDURE in Section 6 must also be performed after any component has been replaced.

1.4 Related Publications

Narkomed M Operator's Manual, Part Number 4114107-001

1.5 Symbol Definitions

CAUTION: Refer to accompanying documents before operating equipment.

CAUTION: Risk of electric shock. Do not remove cover. Refer servicing to a qualified technical service representative.

Degree of protection against electric shock: Type B.

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2.0 Diagnostics

The Narkomed M contains a diagnostic system that monitors certain system functions and records their operational status. Following a brief System Startup display at power up, the diagnostics screen shown in Figure 2-1 appears. This display includes one of three messages at the completion of the diagnostics

FUNCTIONAL: This message indicates that the Narkomed M has passed all power-up tests and is fully functional. The machine will proceed to the MACHINE MONITOR screen after a short delay.

CONDITIONALLY FUNCTIONAL: This message indicates that a minor problem has been detected. The NARKOMED M will retain this display until any key is pressed, then the MACHINE MONITOR screen will be displayed.

NON-FUNCTIONAL: this message indicates that a serious problem has been detected. The machine will not proceed into the MACHINE MONITOR or SYSTEM MONITOR screen.

The PREVENTIVE MAINTENANCE DUE message will appear on the screen if the current date exceeds the Periodic Manufacturer's Service due date stored in the machine.

Further diagnostic functions are available through service screens that can be called up at the display panel. The following paragraphs provide a description of each service screen that can be accessed at the display. If no display is present upon system power-up, refer to Section 3 of this manual for troubleshooting assistance.

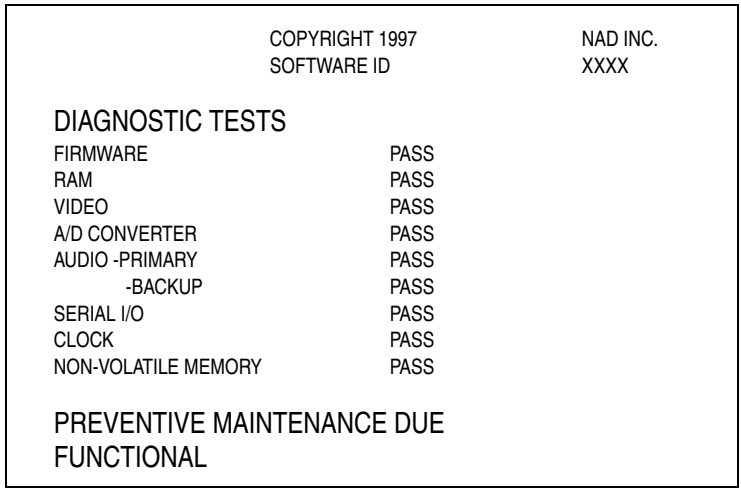

Figure 2-1. Power-Up Diagnostics Screen

2.1 Main Service Screen

2.1.1 View Mode

The Main Service Screen displays the machine serial number, the last service date, hours run since last service and total hours run.

To access the Main Service Screen, press and hold the Oxygen High Limit and Volume Low Limit keys, and press the ▲ key. The View Mode service screen shown in Figure 2-2 will then appear.

Press the ▲ key to proceed to the Service Mode as shown in Figure 2-3, or press the key next to EXIT to return to the monitoring sereen.

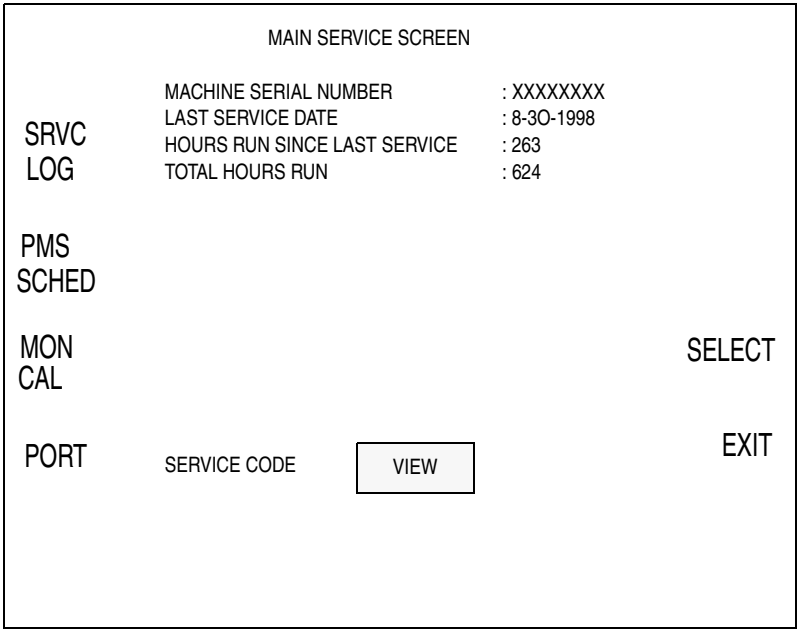

Figure 2-2. Main Service Screen, View Mode

2.1.2 Service Mode

In this screen, the Service Code changes to SRVC.

Press the key next to SELECT to enable the Technical Service ID entry as described on the next page.

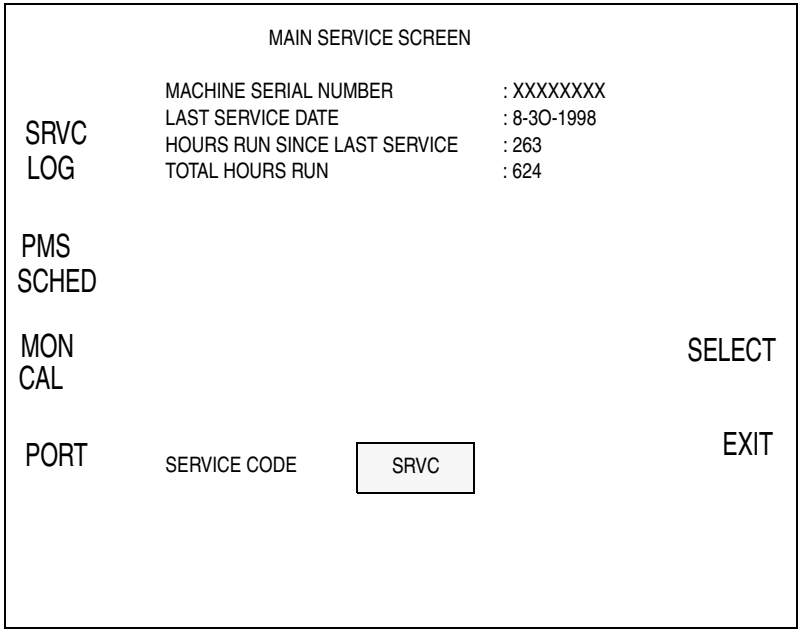

Figure 2-3. Main Service Screen, Service Mode

2.1.3 Service Mode: I.D. Entry

The Service Mode screen appears as shown in Figure 2-4. Press the key next to SELECT. Enter the first digit of your service code by using the ▲ and ▼ keys to display the desired character. Press the key next to SELECT to advance to the next digit, and enter the next and remaining I.D. characters in the same manner.

When this screen is entered, an entry is made in the Service Log.

To access any of the other service screens described on the following pages, press the key next to the desired function on the left side of the screen: Service Log, PMS Schedule, Monitor Calibration, or Port communication settings.

Pressing the key next to RESET will reset the HOURS RUN SINCE LAST SERVICE to zero, and the LAST SERVICE DATE to the current date.

If desired, press the key next to EXIT to return to the monitoring screen.

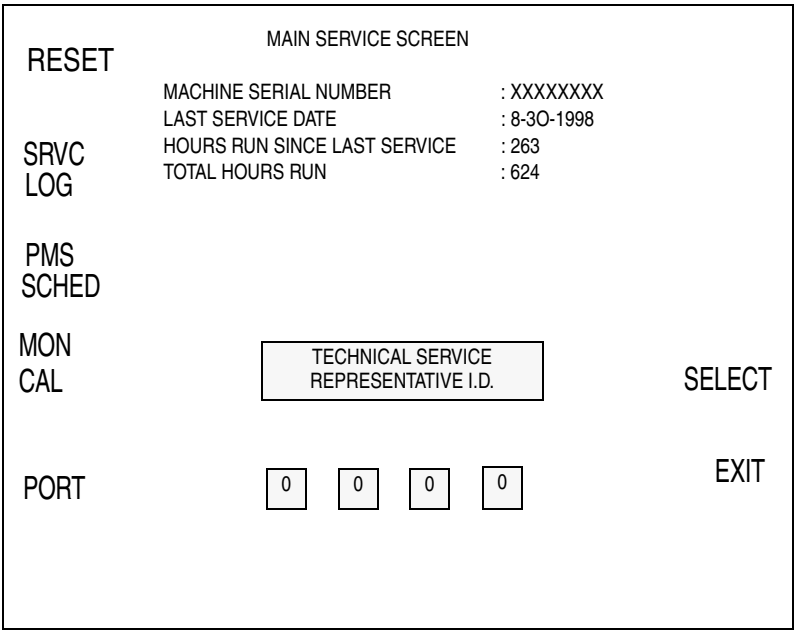

Figure 2-4. Main Service Screen, ID Entry

2.2 Service Log

From the Service Screen (described earlier), press the key next to SRVC LOG.

Figure 2-5 shows an example of the screen that will appear. This screen allows you to view the events recorded in the machine's service log. Use the ▼ and ▲ keys to scroll down or up through the log entries.

Press the key next to EXIT to return to the Main Service Screen.

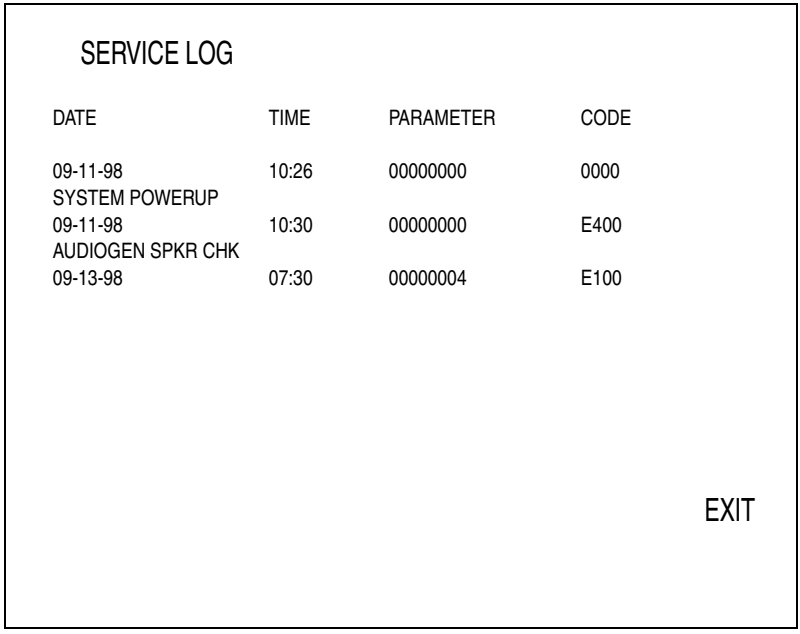

Figure 2-5. Service Log Screen

2.3 PMS Criteria Screen

The PMS Criteria Screen allows you to select the month when the PREVENTIVE MAINTENANCE DUE message appears on the power-up diagnostics screen.

From the Service Screen (described earlier), press the hidden key next to PMS SCHED.

Figure 2-6 shows an example of the screen that will appear. Use the ▲ and ▼ keys to set the desired month.

Press the key next to EXIT to return to the Main Service Screen.

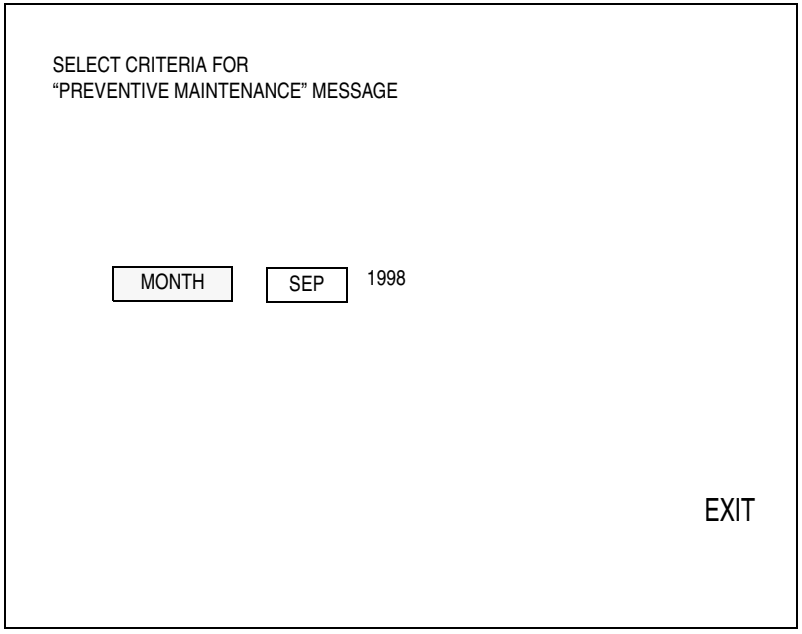

Figure 2-6. PMS Criteria Screen

2.4 Oxygen Monitor Service Screen

The Oxygen Monitor Service Screen shown in Figure 2-7 displays current readings for the O_2 cells, a zero calibration procedure, and the stored calibration values.

From the Service Screen (described earlier), press the key next to MON CAL.

To perform a zero calibration, follow the calibration procedure shown on the screen. Pressing the key next to ZERO stores the current values as the new zero calibration.

To proceed to the Pressure Monitor Service Screen, press the key next to PRES MON. To return to the Main Service Screen, press the key next to EXIT.

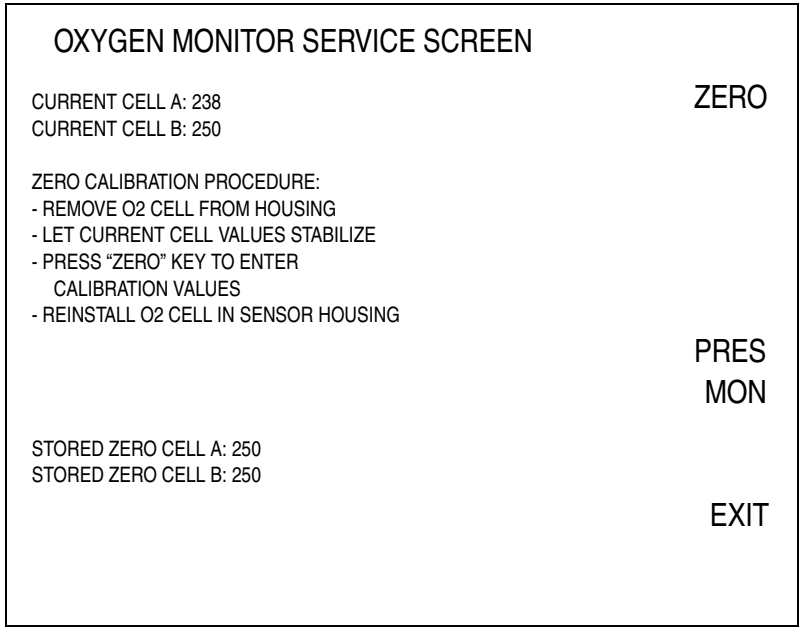

Figure 2-7. Oxygen Monitor Service Screen

2.5 Pressure Monitor Service Screen

The Pressure Monitor Service Screen shown in Figure 2-8 displays the current reading for airway pressure, a procedure for zero and span calibration, and the stored calibration values.

To enter the Pressure Monitor Service Screen from the Oxygen Monitor Service Screen (described earlier), press the key next to PRES MON (ref. Figure 2-6).

To perform a zero calibration, follow the procedure shown on the screen. Pressing the key next to ZERO stores the current value as the new zero calibration.

To perform a span calibration, follow the procedure shown on the screen. Pressing the key next to SPAN stores the current value as the new span calibration.

To return to the Oxygen Monitor Service Screen, press the key next to OXY MON. To return to the Main Service Screen, press the key next to EXIT.

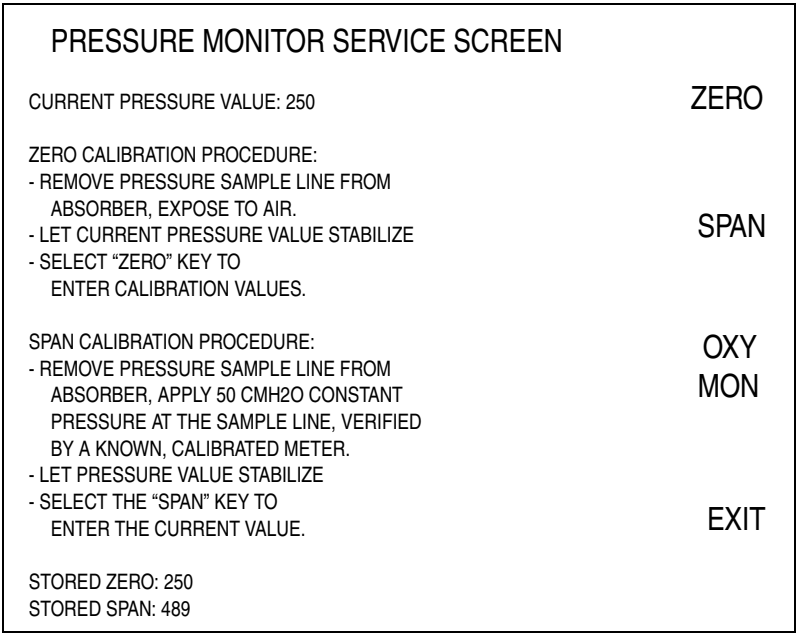

Figure 2-8. Pressure Monitor Service Screen

2.6 Serial Port Configuration Screen

The Serial Port Configuration screen shown in Figure 2-9 allows you to set the machine parameters for communicating with external devices.

From the Service Screen (described earlier), press the key next to PORT.

Use the ▼ and ▲ keys to change the settings; press the key next to SELECT to move to the next setting.

Press the key next to EXIT to return to the Main Service Screen.

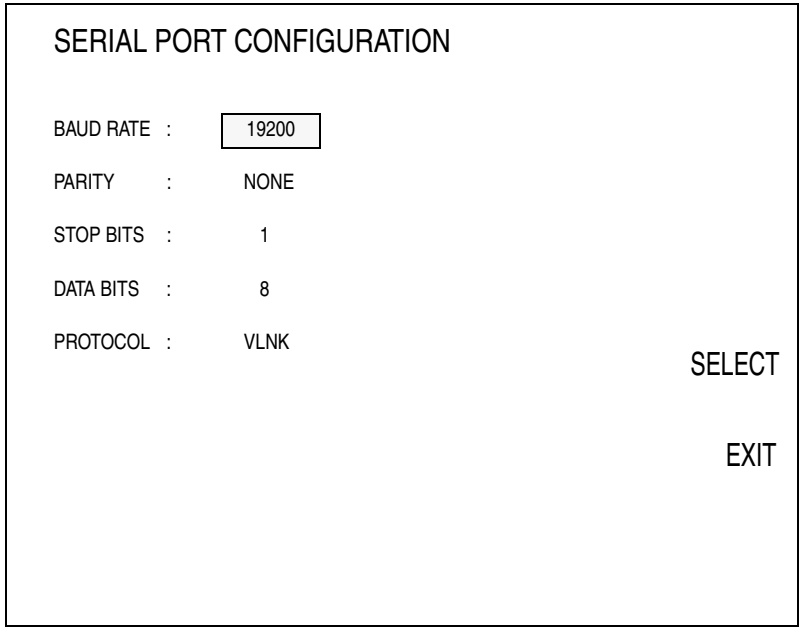

Figure 2-9. Serial Port Configuration Screen

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3.0 Troubleshooting

This section contains information to assist the Draeger Medical, Inc. qualified Technical Service Representative (TSR) in locating electrical faults affecting the NARKOMED M monitoring and display devices. Since most troubleshooting efforts begin with verifying power supply voltages, the following paragraph outlines the voltage distribution scheme within the machine along with test points for each of the voltages.

3.1 Power Supply and Voltage Distribution

In the NARKOMED M, +5VDC, +12VDC and -12VDC are supplied to J14 on the processor board; +8VDC is supplied to J2 on the ventilator controller. These voltages can be measured at the connectors shown in Figure 3-1. Output voltage of the primary power supply is measured at J3 on the Condor supply. Table 3-1 lists the acceptable range for each voltage under normal load conditions. Figure 3-2 shows a block diagram of the Narkomed M voltage distribution scheme.

Table 3-1. Test Points and Allowable Ranges

PROCESSOR	VOLTAGE	ACCEPTABLE RANGE
J14-12,14 (Red, Orn)	+ 5 VDC	4.80 to 5.25 VDC
J14-1 (Wht)	+ 12 VDC	11.65 to 12.85 VDC
J14-5 (Gry)	- 12 VDC	-11.50 to -13.00 VDC
J14-7,8,9 (Grn, Blu, Yel)	Common	
VENTILATOR CONTROLLER	**VOLTAGE**	**ACCEPTABLE RANGE**
J2-3 (Brn)	+ 8 VDC	7.70 to 8.30 VDC
J2-1 (Yel)	Common	
CONDOR PWR SUPP	**VOLTAGE**	**ACCEPTABLE RANGE**
J3-1 (Brn)	+ 15 VDC	14.0 to 16.0 VDC
J3-8 (Wht)	Common	

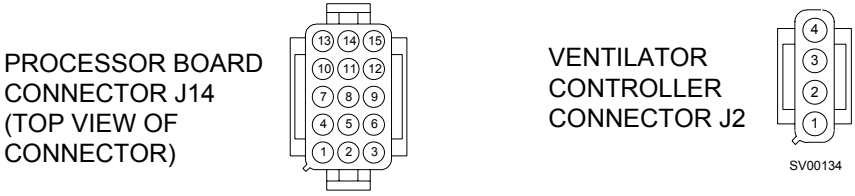


Figure 3-1. Power Supply Voltage Test Points

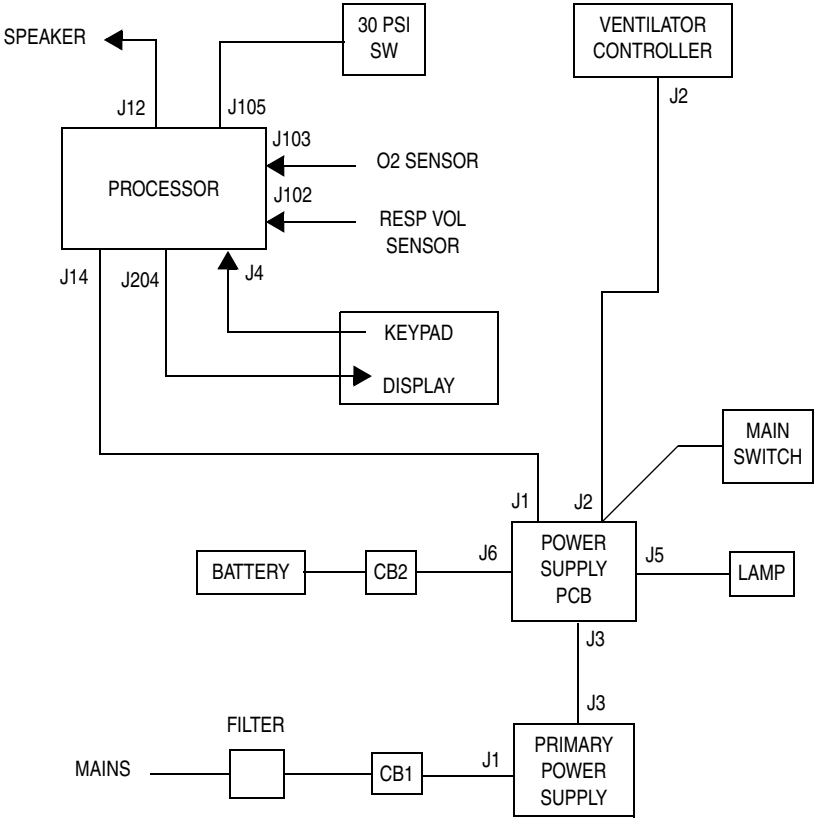


Figure 3-2. Narkomed M Power Distribution

NOTE: The Narkomed M will not turn on, or operate, unless the power cable is connected to J14 on the processor board. Disconnecting this cable breaks a sense connection that automatically powers down +5V, +12V, -12V, and +8V.

3.2 Battery

While the machine is operating from an AC line, the battery voltage at full charge should be within the range of 13.50 to 14.80 VDC. Battery voltage can be measured at the battery terminals. During battery operation, the low battery cutoff voltage should be within the range of 10.5 to 10.0 VDC.

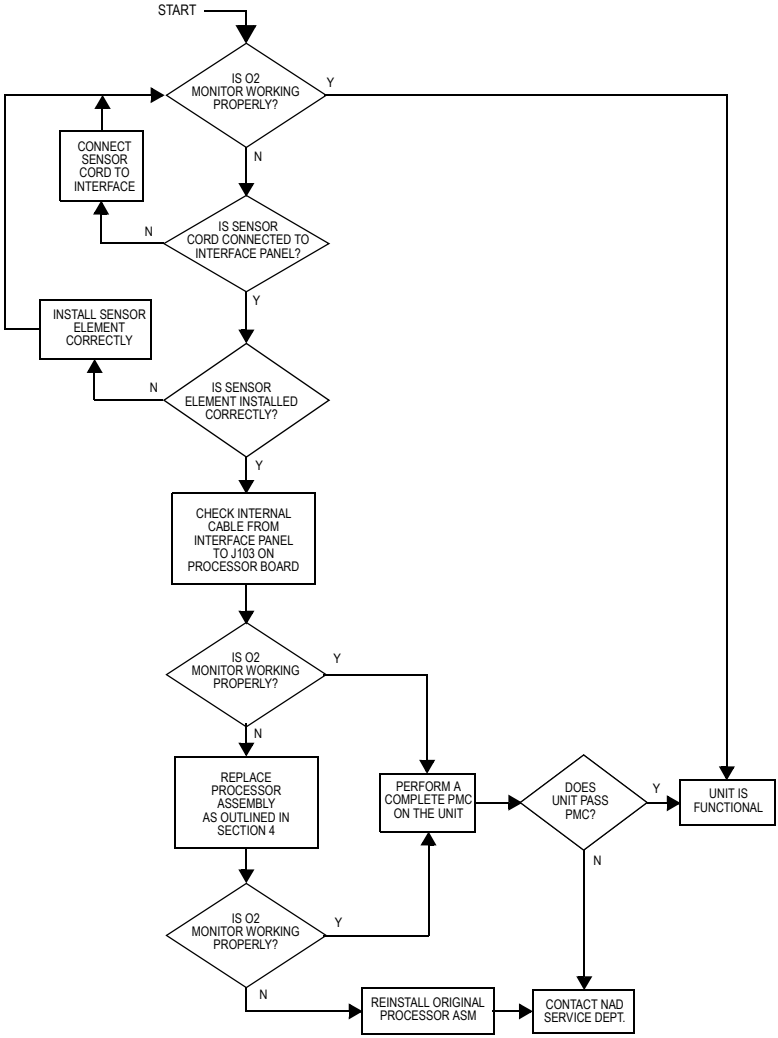
3.3 Troubleshooting Guides

Table 3-2 lists common failure modes and symptoms (excluding simultaneous multiple faults) for the monitoring and display devices in the NARKOMED M. Each failure mode or symptom is keyed to a troubleshooting guide flow chart at the back of this section to assist the TSR in locating a problem. These flow charts assume that the machine is plugged into an AC outlet with the correct voltage, and the machine is not running on its backup battery.

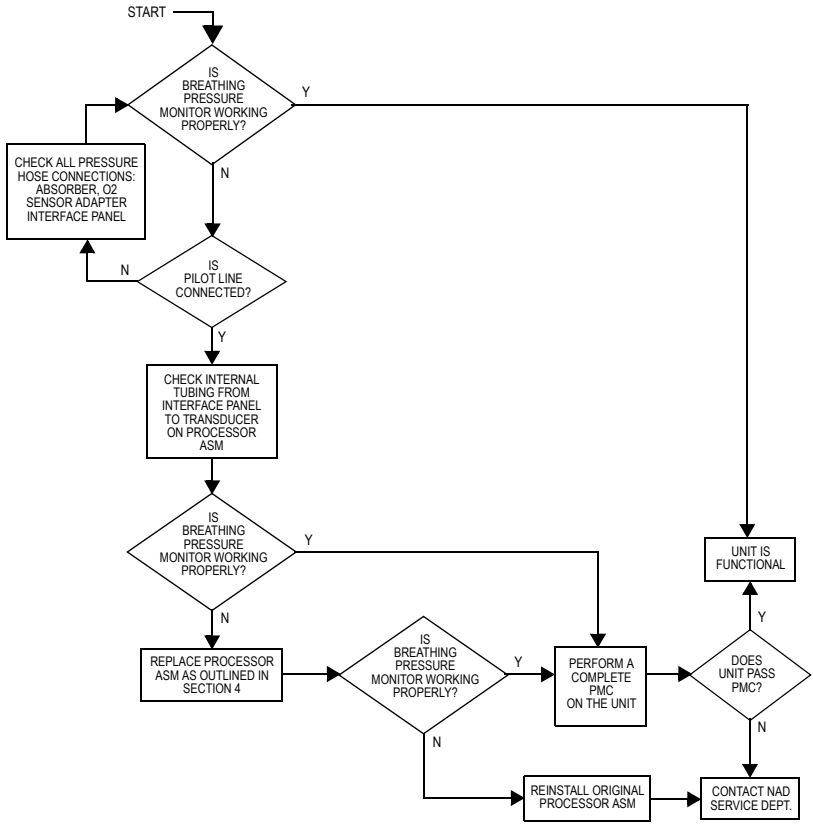
Table 3-2. Narkomed M Failure Mode and Symptom List

FAILURE MODE / SYMPTOM	CORRECTIVE ACTION
Loss of O_2 Monitor	Guide 1
Loss of Breathing Pressure Monitor	Guide 2
Loss of Respiratory Volume Monitor	Guide 3
No Audio Alarms	Guide 4
Serial Port Communication Failure	Guide 5
No Oxygen Supply Pressure Alarms	Guide 6
Display Blank Upon System Power-up	Guide 7
Keypad Inoperative	Guide 8
Ventilator Inoperative	Guide 9

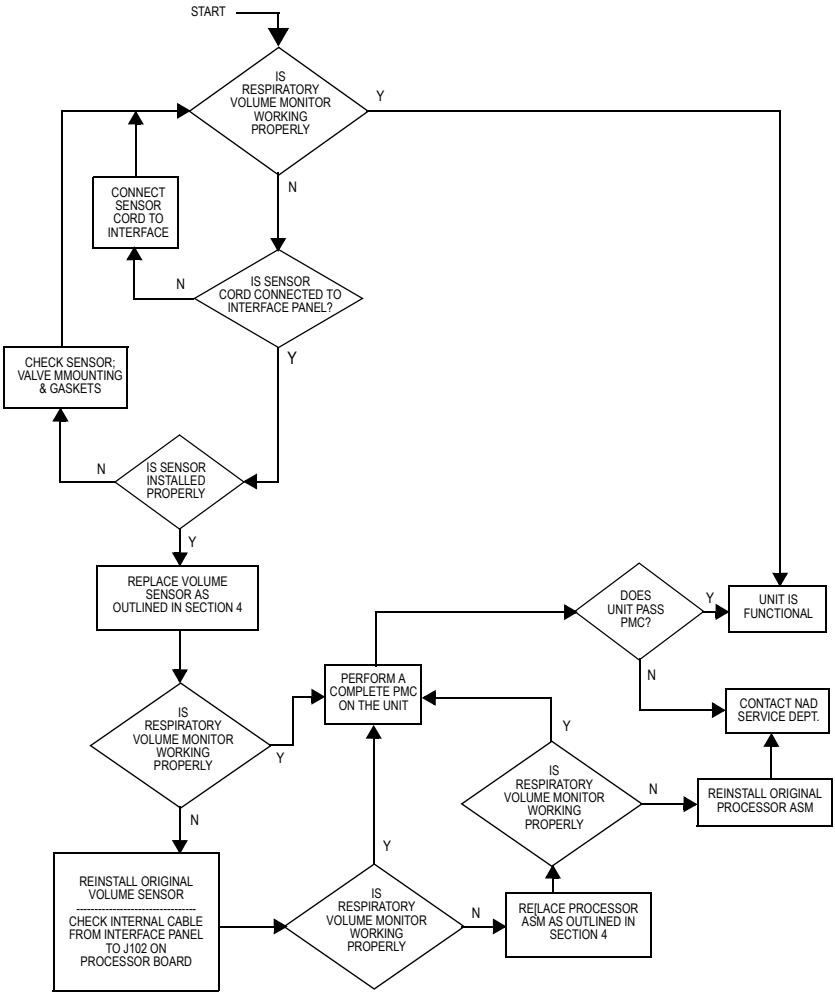
GUIDE 1: Loss of O_2 Monitor



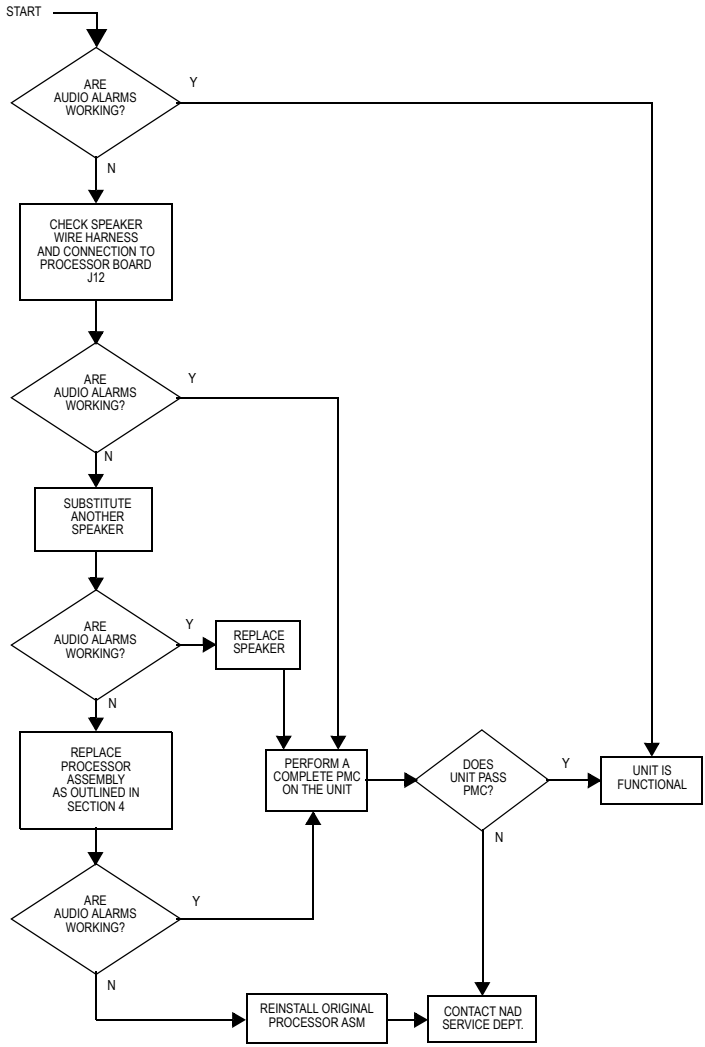
GUIDE 2: Loss of Breathing Pressure Monitor



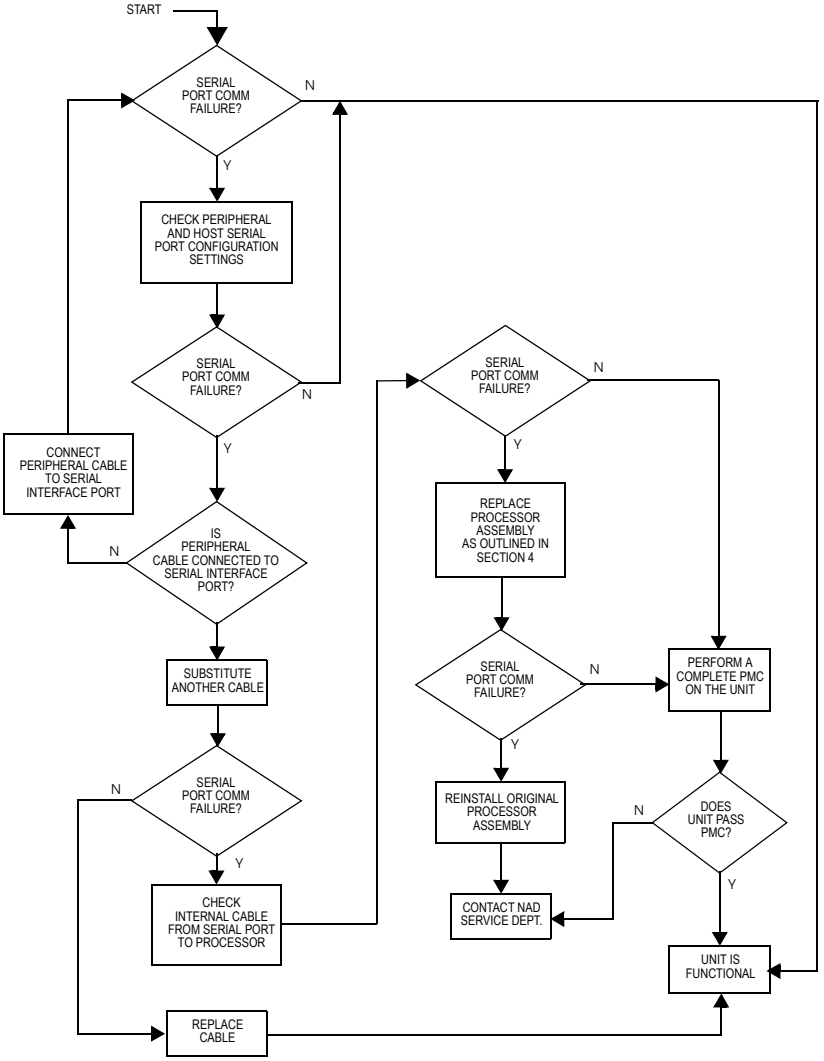
GUIDE 3: Loss of Respiratory Volume Monitor



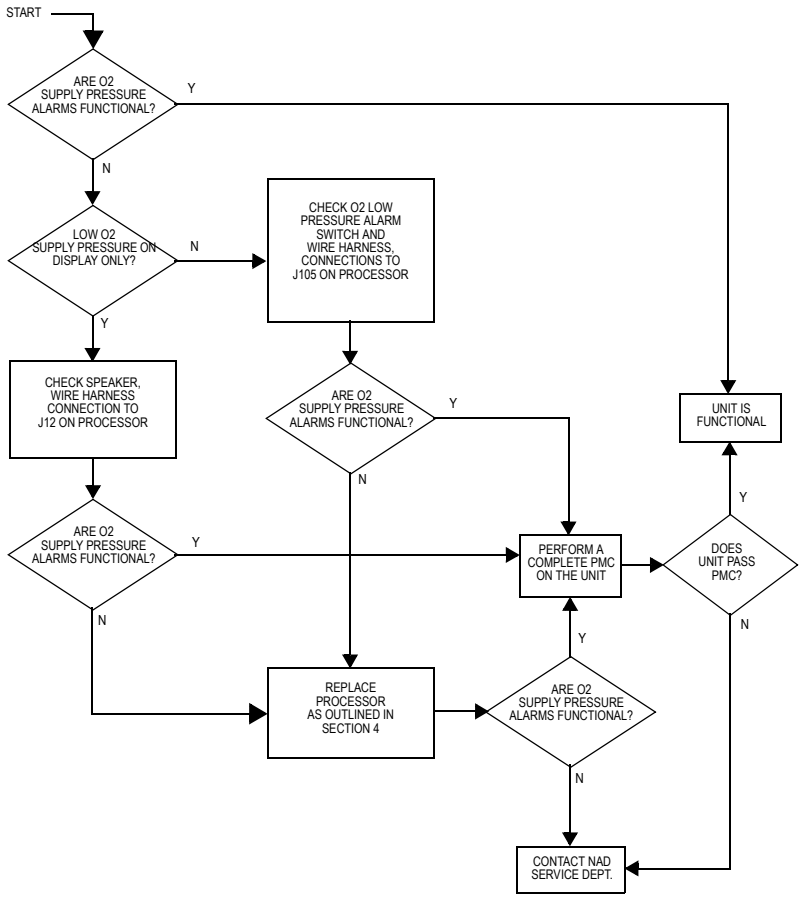
GUIDE 4: No Audio Alarms



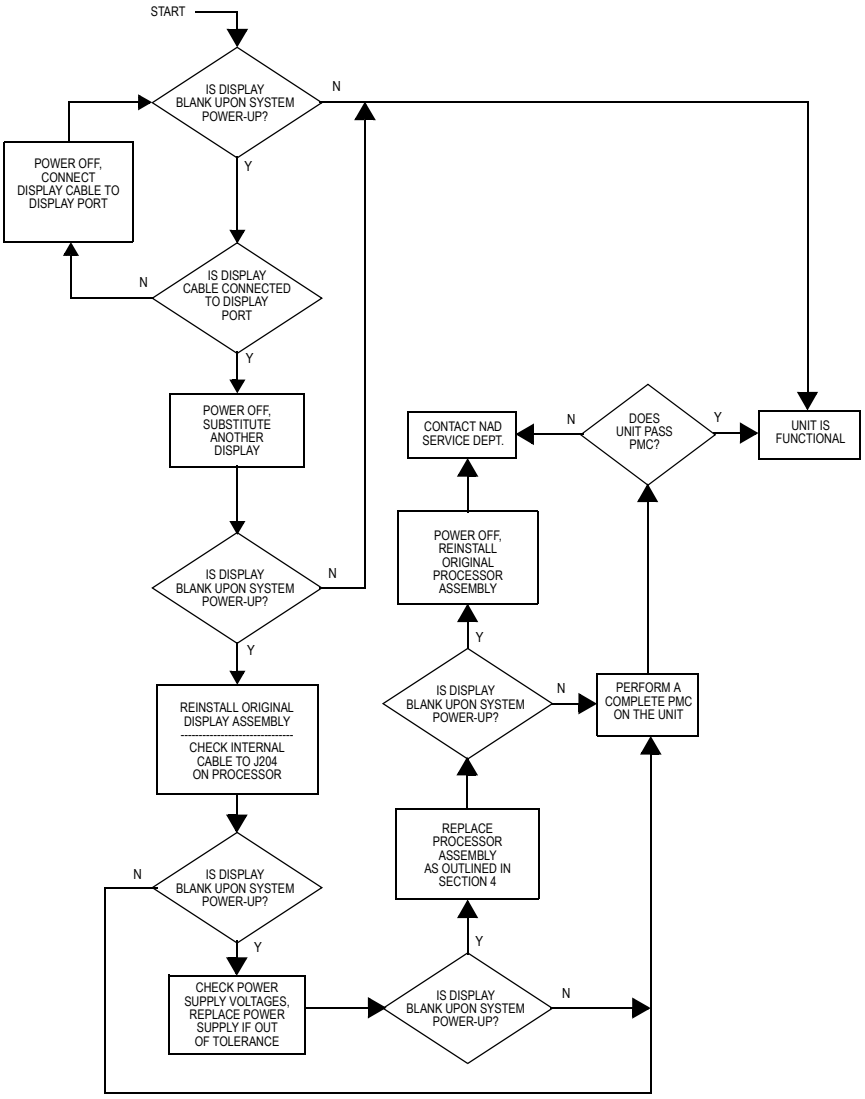
GUIDE 5: Serial Port Communication Failure



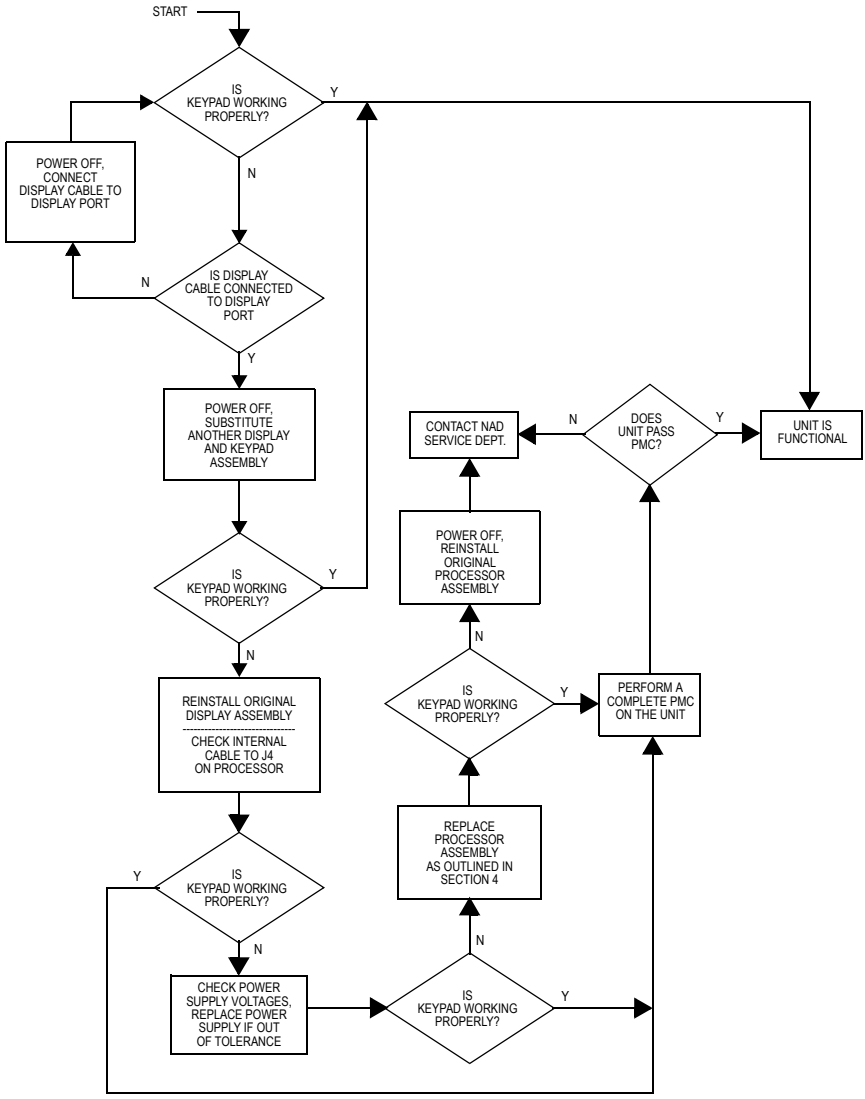
GUIDE 6: No O_2 Supply Pressure Alarms



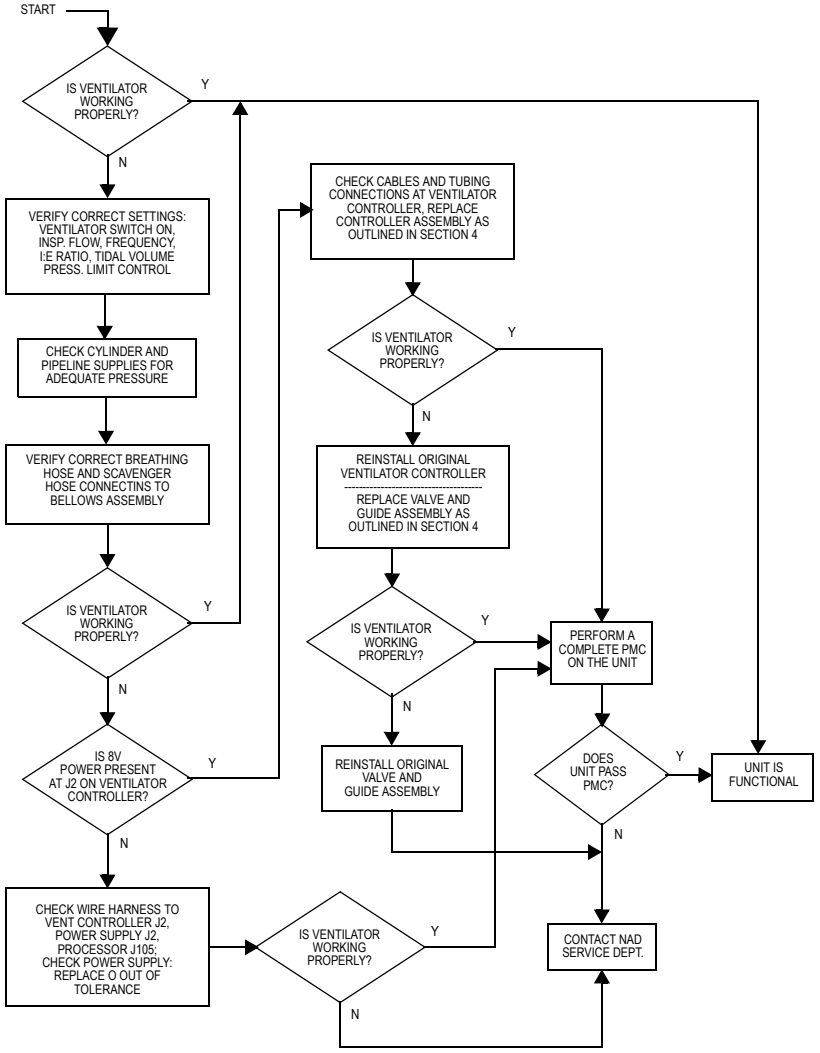
GUIDE 7: Display Blank Upon System Power-up



GUIDE 8: Keypad Inoperative



GUIDE 9: Ventilator Inoperative


START
IS VENTILATOR WORKING PROPERLY?
Y
N
VERIFY CORRECT SETTINGS: VENTILATOR SWITCH ON, INSP. FLOW, FREQUENCY, I:E RATIO, TIDAL VOLUME PRESS. LIMIT CONTROL
CHECK CYLINDER AND PIPELINE SUPPLIES FOR ADEQUATE PRESSURE
VERIFY CORRECT BREATHING HOSE AND SCAVENGER HOSE CONNECTINS TO BELLOWS ASSEMBLY
IS VENTILATOR WORKING PROPERLY?
Y
N
IS 8V POWER PRESENT AT J2 ON VENTILATOR CONTROLLER?
Y
N
CHECK WIRE HARNESS TO VENT CONTROLLER J2, POWER SUPPLY J2, PROCESSOR J105; CHECK POWER SUPPLY: REPLACE O OUT OF TOLERANCE
IS VENTILATOR WORKING PROPERLY?
Y
N
CHECK CABLES AND TUBING CONNECTIONS AT VENTILATOR CONTROLLER, REPLACE CONTROLLER ASSEMBLY AS OUTLINED IN SECTION 4
IS VENTILATOR WORKING PROPERLY?
Y
N
REINSTALL ORIGINAL VENTILATOR CONTROLLER
REPLACE VALVE AND GUIDE ASSEMBLY AS OUTLINED IN SECTION 4
IS VENTILATOR WORKING PROPERLY?
Y
N
REINSTALL ORIGINAL VALVE AND GUIDE ASSEMBLY
PERFORM A COMPLETE PMC ON THE UNIT
DOES UNIT PASS PMC?
Y
N
UNIT IS FUNCTIONAL
CONTACT NAD SERVICE DEPT.

4.0 Replacement Procedures

This section outlines removal and replacement procedures for the field-replaceable assemblies of the Narkomed M Anesthesia System.

These procedures are to be performed only by a Draeger Medical, Inc. qualified Technical Service Representative (TSR).

The following are the only procedures authorized by Draeger Medical, Inc. to be performed in the field. All other service procedures shall be referred to the Draeger Medical, Inc. Technical Service Department.

NOTE: The PMC PROCEDURE given in Section 6 must be performed after any replacement, removal, calibration or adjustment procedure.

4.1 Cylinder Yoke and Regulator Assembly

The cylinder yoke and regulator are furnished as an assembly consisting of the yoke, check valve, regulator and spacer block. Access to the assembly requires removal of the flowmeter housing back cover. Tubing disconnects and mounting arrangement are shown in Figure 4-1.

4.1.1 Disconnect all pipeline hoses and turn the System Power switch to ON.

4.1.2 Open the oxygen cylinder valve.

4.1.3 Set the oxygen flow to 5 liters per min.

4.1.4 Open the other gas flow control valves to drain pressure from the system.

4.1.5 Close the O_2 cylinder valve, and close the flow control valves. Press the O_2 Flush valve to drain oxygen pressure from the system.

4.1.6 Remove the O_2 cylinder from the yoke.

4.1.7 Turn the System Power switch to STANDBY.

4.1.8 Remove the flowmeter housing back cover.

4.1.9 Disconnect both ends of the ¼ in. diameter copper tube from the regulator to the O_2 pipeline inlet assembly, and remove the tube.

4.1.10 Disconnect the ¼ in. diameter copper tube from the regulator to the main switch assembly - at the main switch assembly.

4.1.11 Disconnect the 3/16 in. diameter copper tube from the regulator to the cylinder pressure gauge - at the gauge.

4.1.12 Remove the yoke spacer mounting screws, and lift the assembly from the flowmeter housing.

4.1.13 Record the serial number of the regulator that was removed, and record the serial number of the replacement regulator.

4.1.14 Transfer the 3/16 in. diameter copper tube to the L-fitting on the bottom of the replacement regulator.

4.1.15 Transfer the short ¼ in. diameter copper tube to the bottom of the T-fitting on the replacement regulator.

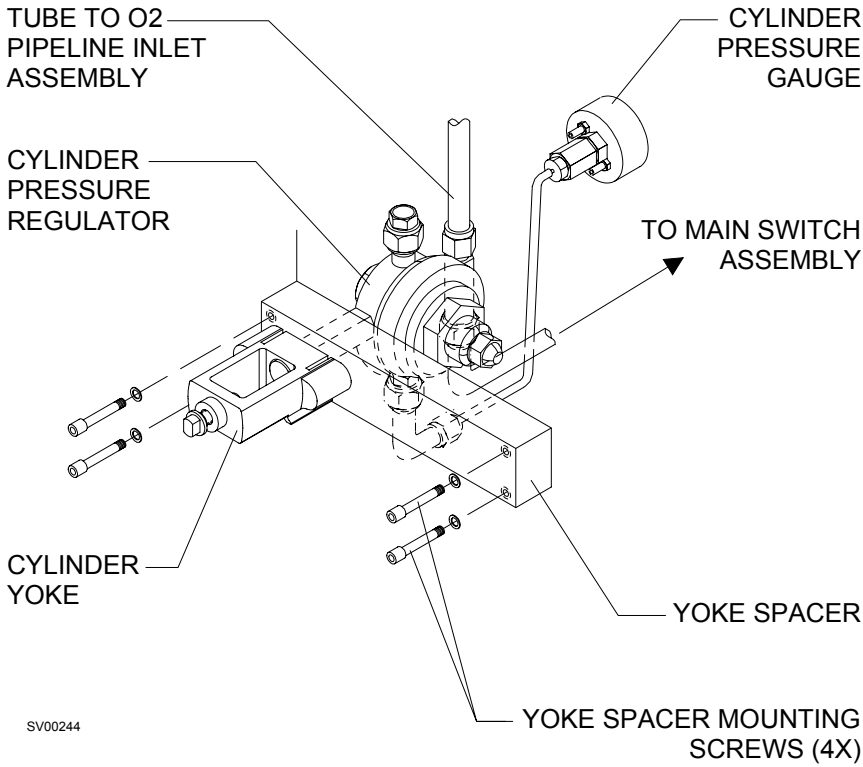


Figure 4-1. Cylinder Yoke and Regulator Assembly

4.1.16 Position the replacement yoke and regulator assembly in the flowmeter housing, and secure it with the hardware that was previously removed.

4.1.17 Reconnect the 3/16 in. diameter copper tube to the cylinder pressure gauge.

4.1.18 Reconnect the short ¼ in. diameter copper tube to the main switch assembly.

4.1.19 Reinstall the ¼ in. diameter copper tube from the regulator to the O_2 pipeline inlet assembly. Tighten all compression fittings securely.

4.1.20 Reinstall the cylinder in the yoke.

4.1.21 Measure (and adjust if necessary) the regulator output pressure in accordance with the procedure given in Section 5.

4.1.22 Reinstall the flowmeter housing back cover.

4.1.23 Perform the PMC Procedure given in Section 6.

4.2 Cylinder and Pipeline Pressure Gauges

Replacement of the cylinder and pipeline pressure gauges requires that the plexiglass front cover be removed from the flowmeter assembly, and also the flowmeter housing back cover for access to the gauge connections. Figure 4-2 shows gauge mounting and connection details.

4.2.1 Disconnect all pipeline hoses and turn the System Power switch to ON.

4.2.2 Open the oxygen cylinder valve.

4.2.3 Set the oxygen flow to 5 liters per min.

4.2.4 Open the other gas flow control valves to drain pressure from the system.

4.2.5 Close the O_2 cylinder valve, and close the flow control valves. Press the O_2 Flush valve to drain oxygen pressure from the system.

4.2.6 Turn the System Power switch to STANDBY.

4.2.7 Remove the oxygen flow control knob.

4.2.8 Remove the two screws holding the knob guard in place, and remove the knob guard.

4.2.9 Remove the plexiglass flowmeter shield.

4.2.10 Remove the flowmeter housing back cover.

4.2.11 For the cylinder pressure gauge:

Disconnect the 3/16 in. copper tube compression fitting at the back of the gauge.

For the pipeline pressure gauges:

Remove the press-on hose clamp and disconnect the flex tubing from the hose barb at the back of the gauge.

4.2.12 Remove the gauge mounting nuts and remove the gauge from the front of the flowmeter assembly.

4.2.13 Install the replacement gauge in the flowmeter assembly and secure it with the hardware that was previously removed.

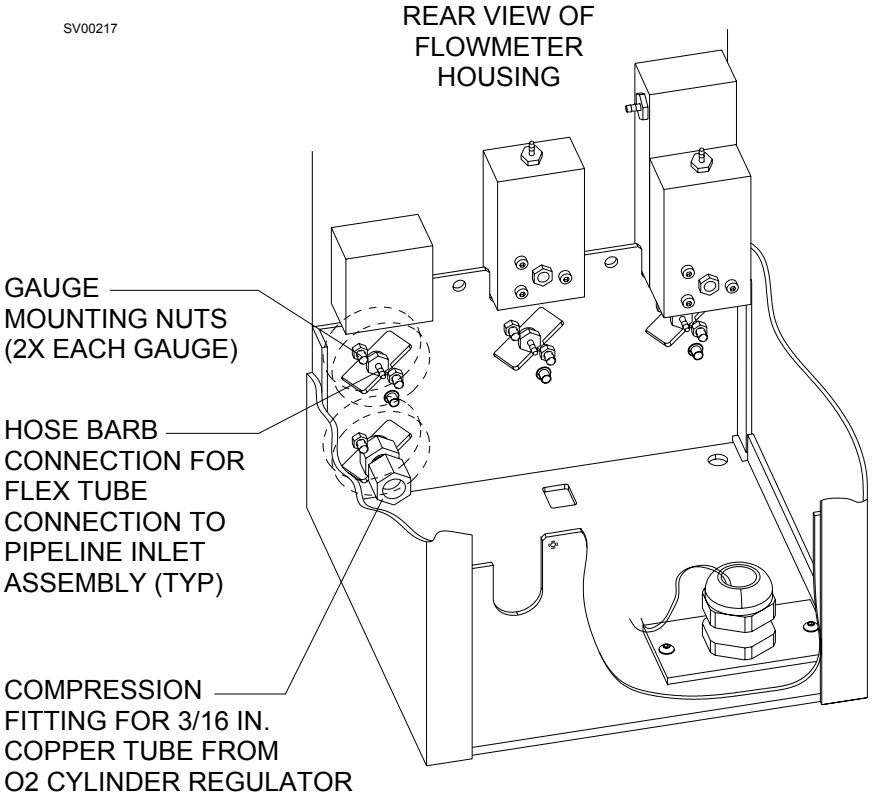

SV00217
REAR VIEW OF FLOWMETER HOUSING
GAUGE MOUNTING NUTS (2X EACH GAUGE)
HOSE BARB CONNECTION FOR FLEX TUBE CONNECTION TO PIPELINE INLET ASSEMBLY (TYP)
COMPRESSION FITTING FOR 3/16 IN. COPPER TUBE FROM O2 CYLINDER REGULATOR

Figure 4-2. Cylinder and Pipeline Pressure Gauges

4.2.14 For the cylinder pressure gauge:

Reconnect the 3/16 in. copper tube compression fitting at the back of the gauge.

For the pipeline pressure gauges:

Reconnect the flex tubing from to the hose barb at the back of the gauge, and secure it with the press-on hose clamp.

4.2.15 Reinstall the front plexiglass flowmeter shield.

4.2.16 Reinstall the knob guard and secure it with the two mounting screws.

4.2.17 Reinstall the oxygen flow control knob.

4.2.18 Reinstall the flowmeter housing back cover.

4.2.19 Connect the pipeline supplies.

4.2.20 Perform the PMC Procedure given in Section 6.

4.3 Flowmeters

The flowmeter tubes are held by compression in gaskets at the top and bottom of each tube. Each upper gasket is seated in an adjustable retainer that allows removal of the tube as shown in Figure 4-3. Access to the flow tubes and their retainers requires removal of the plexiglass flowmeter shield.

4.3.1 Disconnect all pipeline hoses and turn the System Power switch to ON.

4.3.2 Open the oxygen cylinder valve.

4.3.3 Set the oxygen flow to 5 liters per min.

4.3.4 Open the other gas flow control valves to drain pressure from the system.

4.3.5 Close the O_2 cylinder valve and the O_2 flow control valve. Press the O_2 Flush valve to drain oxygen pressure from the system.

4.3.6 Turn the System Power switch to STANDBY.

4.3.7 Remove the oxygen flow control knob.

4.3.8 Remove the two screws holding the knob guard in place, and remove the knob guard.

4.3.9 Remove the plexiglass flowmeter shield.

4.3.10 Turn the flow tube retainer as shown in the illustration until you can pull the top of the flow tube outward, and remove the tube.

NOTE: If the bottom of the tube is seated in a restrictor housing, be sure that the arrangement of the restrictor and its gaskets is not disturbed.

4.3.11 Make sure that the replacement flow tube bears the correct markings and has a ball.

CAUTION: The flow tube must be properly centered over the guide rings or damage to the flow tube may occur.

4.3.12 Place the bottom of the flow tube into the guide ring of the lower gasket, and position the top of the flow tube in the center of the retainer.

CAUTION: Do not over-tighten the retainer. Over-tightening the retainer may break the flowmeter tube.

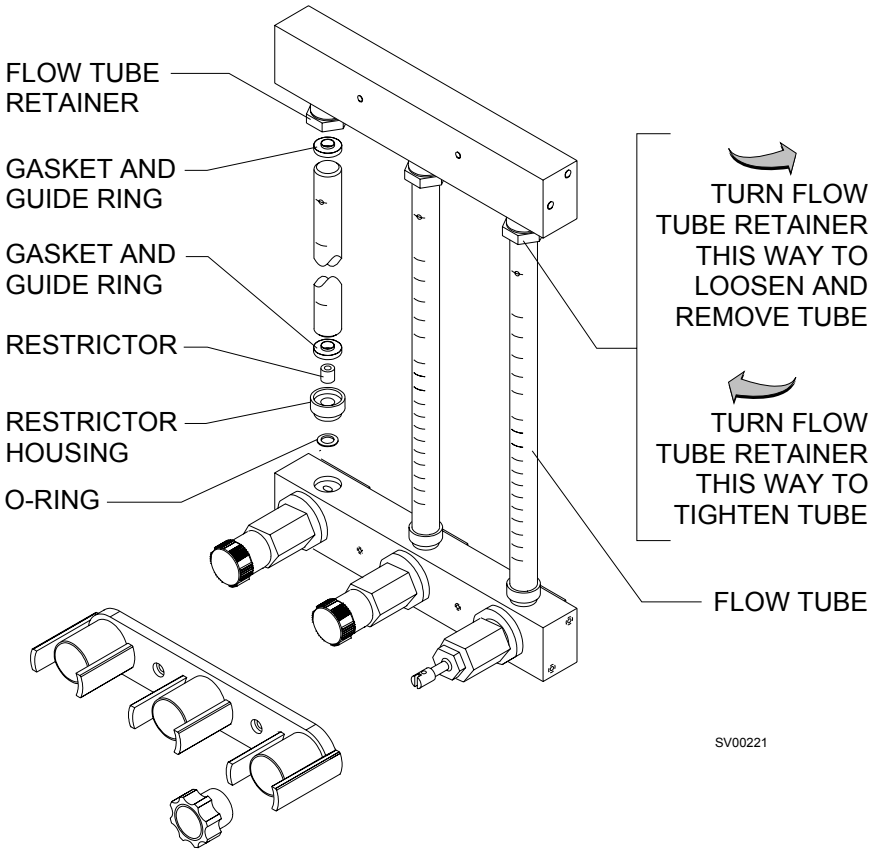


Figure 4-3. Flow Tube Replacement

4.3.13 Ensure that the markings on the flow tube are facing forward, and turn the retainer as shown in the illustration until the flow tube is firmly held in place.

4.3.14 Perform the following leak test on the system:

Disconnect the absorber hose from the fresh gas outlet. Ensure that all flow control valves are closed.

Connect a test gauge and B.P. bulb to the fresh gas outlet, and pressurize the system to 50 cm H_2O.

The pressure should not drop more than 10 cm H_2O in thirty seconds.

4.3.15 Disconnect the test gauge and re-connect the absorber hose to the fresh gas outlet.

4.3.16 Reinstall the front plexiglass flowmeter shield.

4.3.17 Reinstall the knob guard and secure it with the two mounting screws.

4.3.18 Reinstall the oxygen flow control knob.

4.3.19 Connect the pipeline hoses.

4.3.20 Perform the PMC Procedure given in Section 6.

4.4 Auxiliary O2 Flowmeter

The auxiliary O_2 flowmeter is attached to the side of the flowmeter housing. Access to its attaching hardware requires removal of the flowmeter housing back cover, and removal of the oxygen ratio controller (ORC) from the flowmeter sub-assembly. Figure 4-4 shows the arrangement of the mounting screws and O_2 supply line.

4.4.1 Disconnect all pipeline hoses and turn the System Power switch to ON.

4.4.2 Open the oxygen cylinder valve.

4.4.3 Set the oxygen flow to 5 liters per min.

4.4.4 Open the other gas flow control valves to drain pressure from the system.

4.4.5 Close the O_2 cylinder valve and the O_2 flow control valve. Press the O_2 Flush valve to drain oxygen pressure from the system.

4.4.6 Turn the System Power switch to STANDBY.

4.4.7 Remove the flowmeter housing back cover.

4.4.8 Remove the copper N_2O line between the N_2O OFPD and the N_2O pipeline inlet assembly.

4.4.9 Remove the press-on hose clamp and disconnect the small diameter tubing from the hose barb at the top of the OFPD.

4.4.10 Remove the press-on hose clamp and disconnect the small diameter tubing from the hose barb on the side of the ORC.

4.4.11 Remove the three screws securing the OFPD and the ORC to the flowmeter sub-assembly, and remove the OFPD and ORC from the flowmeter housing.

4.4.12 Remove the press-on hose clamp and disconnect the flexible auxiliary O_2 supply line from the hose barb on the O_2 pipeline inlet assembly.

4.4.13 Remove the screws securing the auxiliary O_2 flowmeter to the side of the flowmeter housing, and remove the flowmeter.

4.4.14 Position the replacement flowmeter at the side of the flowmeter housing (feed the flex tubing through the clearance hole) and secure the flowmeter with the two screws that were previously removed.

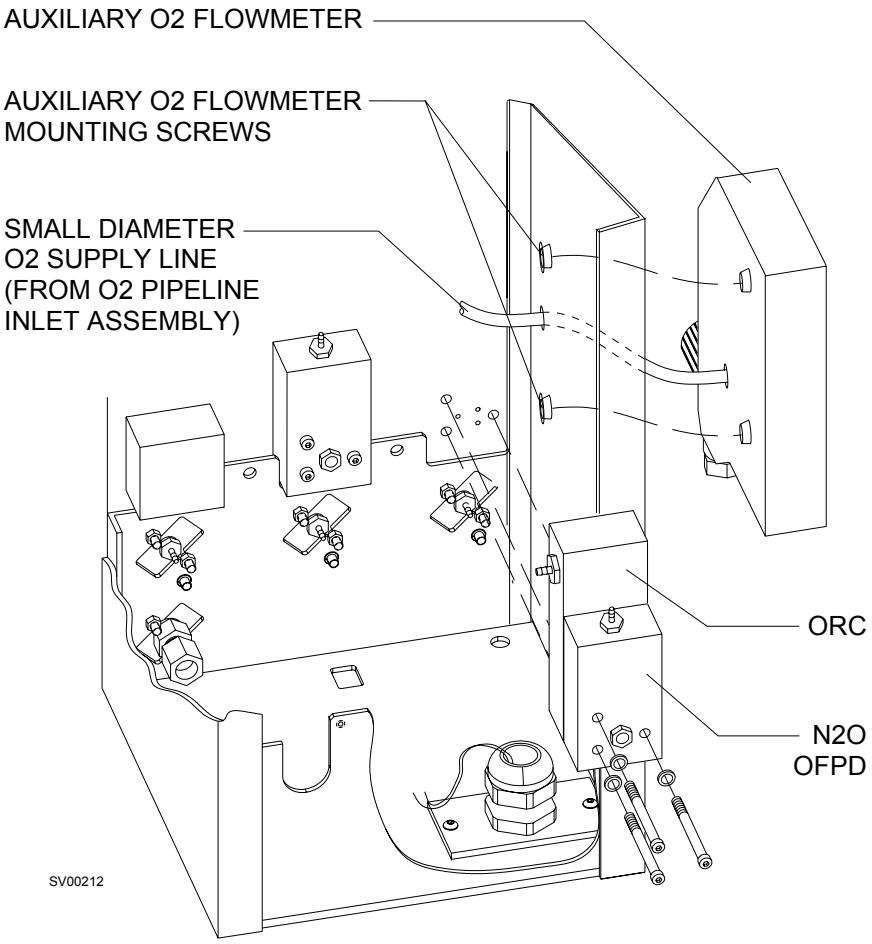


Figure 4-4. Auxiliary O2 Flowmeter

4.4.15 Reconnect the small diameter tubing from the auxiliary O_2 flowmeter to the hose barb on the O_2 pipeline inlet assembly and secure the connection with the press-on hose clamp.

4.4.16 Reinstall the ORC and the OFPD at the back of the N_2O flowmeter sub-assembly; ensure that the three O-rings and filter are in place in the ORC, and the O-ring is in place in the OFPD. Install and tighten the three mounting screws to secure the ORC and OFPD.

4.4.17 Reconnect the small diameter tubing to the hose barb on the ORC and secure the connection with the press-on hose clamp.

4.4.18 Reconnect the small diameter tubing to the hose barb on the OFPD and secure the connection with the press-on hose clamp.

4.4.19 Reinstall the copper N_2O line between the N_2O OFPD and the N_2O pipeline inlet assembly.

4.4.20 Reinstall the flowmeter housing back cover.

4.4.21 Connect the pipeline hoses and restore AC power to the machine.

4.4.22 Perform the PMC Procedure given in Section 6.

4.5 Flow Control Valves

The flow control valves have replaceable elements that are removable from the front of the flowmeter sub-assembly as shown in Figure 4-5. Each flow control knob has a positive stop arrangement that prevents damage to the valve seat. Whenever a valve is replaced the "off stop" must be set as outlined in the following procedure.

4.5.1 Disconnect all pipeline hoses and turn the System Power switch to ON.

4.5.2 Open the oxygen cylinder valve.

4.5.3 Set the oxygen flow to 5 liters per min.

4.5.4 Open the other gas flow control valves to drain pressure from the system.

4.5.5 Close the O_2 cylinder valve and the O_2 flow control valve. Press the O_2 Flush valve to drain oxygen pressure from the system.

4.5.6 Turn the System Power switch to STANDBY.

4.5.7 Remove the oxygen flow control knob.

4.5.8 Remove the two screws holding the knob guard in place, and remove the knob guard.

4.5.9 Remove the plexiglass flowmeter shield.

4.5.10 Remove the knob (if not already removed) from the valve that is being replaced, and remove the stop pin nut.

4.5.11 Remove the flow control valve by holding it at the wrench flats and turning it counter-clockwise.

4.5.12 Install the replacement flow control valve in the flowmeter sub-assembly.

4.5.13 Reinstall the stop pin nut.

4.5.14 Reinstall the front plexiglass flowmeter shield.

4.5.15 Reinstall the knob guard and secure it with the two mounting screws.

4.5.16 Connect the pipeline supplies and turn the System Power switch to ON.

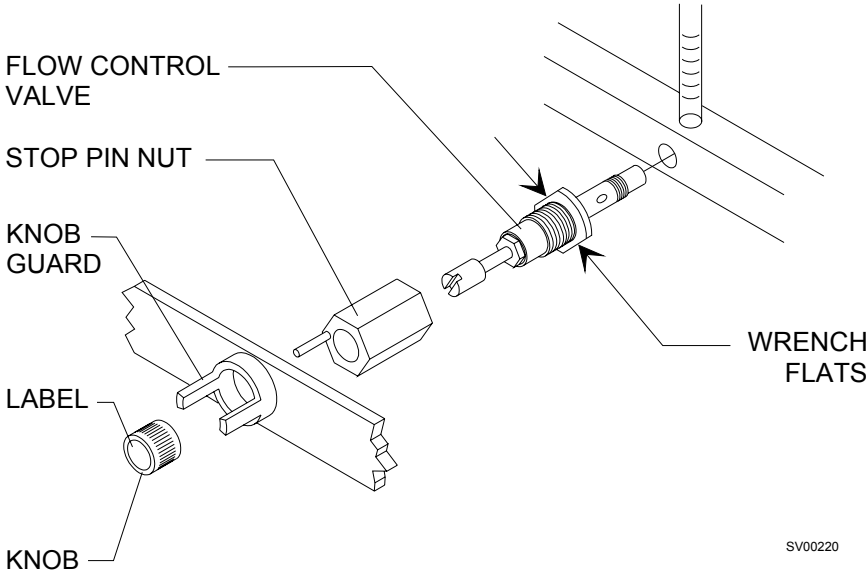


Figure 4-5. Flow Control Valves

4.5.17 For the O_2 flow control valve:

Turn the flow control valve clockwise until the flow rate will not drop any further. (If the machine has been modified to eliminate the minimum flow feature, turn the valve until the flow rate is zero.)

For the other gas flow control valves:

Set the oxygen flow rate to four liters per minute.

Turn the other gas flow control valve clockwise until the flow rate is zero.

4.5.18 Place the knob on the flow control valve shaft and turn it clockwise until it engages the stop pin. Tighten one of the knob setscrews.

4.5.19 Turn the knob in both directions and ensure that the flow can be controlled over its entire range. When the valve is closed, the knob should be against the clockwise stop. Tighten the remaining set screw.

4.5.20 If the knob label is not horizontal when the valve is closed, remove the label and install a new label in the correct position.

4.5.21 Perform the PMC Procedure given in Section 6.

4.6 Oxygen Supply Failure Protection Device

The air and nitrous oxide supplies within the machine are monitored by oxygen supply failure protection devices (OFPDs) which prevent the flow of these gases if there is insufficient oxygen pressure available. Access to these devices requires removal of the flowmeter housing back cover. See Figure 4-6.

4.6.1 Disconnect all pipeline hoses and turn the System Power switch to ON.

4.6.2 Open the oxygen cylinder valve.

4.6.3 Set the oxygen flow to 5 liters per min.

4.6.4 Open the other gas flow control valves to drain pressure from the system.

4.6.5 Close the O_2 cylinder valve and the O_2 flow control valve. Press the O_2 Flush valve to drain oxygen pressure from the system.

4.6.6 Turn the System Power switch to STANDBY.

4.6.7 Air OFPD: Remove the copper air line between the Air OFPD and the air pipeline inlet assembly.

N_2O OFPD: Remove the copper N_2O line between the N_2O OFPD and the N_2O pipeline inlet assembly.

4.6.8 Remove the press-on hose clamp and disconnect the small diameter tubing from the hose barb at the top of the OFPD.

4.6.9 Air OFPD: Remove the three screws securing the OFPD to the flowmeter sub-assembly, and remove the OFPD.

NOTE: The N_2O OFPD has longer mounting screws, which pass through the oxygen ratio controller (ORC) and into the flowmeter sub-assembly. These screws retain both devices.

N_2O OFPD: Remove the three screws securing the OFPD, and remove the OFPD.

4.6.10 Ensure that the O-ring is correctly in place, and install the replacement OFPD with the hardware that was previously removed.

4.6.11 Reconnect the small diameter tubing to the hose barb on the OFPD and secure the connection with the press-on hose clamp.

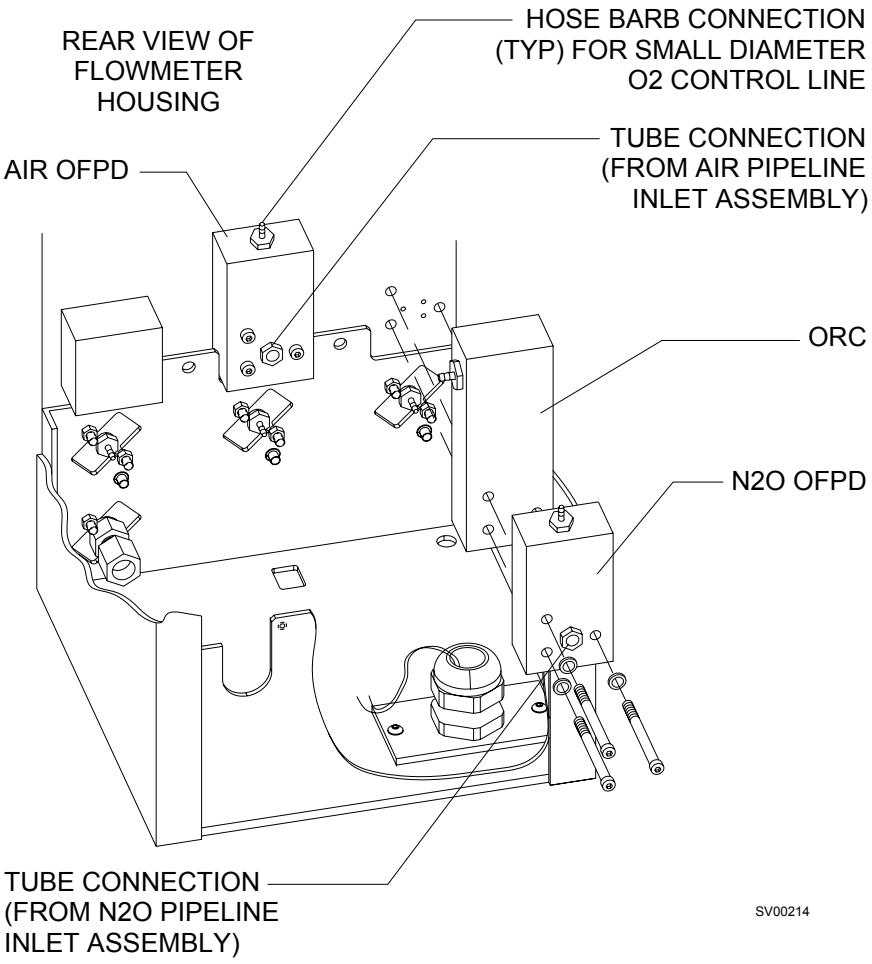

REAR VIEW OF FLOWMETER HOUSING
HOSE BARB CONNECTION (TYP) FOR SMALL DIAMETER O2 CONTROL LINE
AIR OFPD
TUBE CONNECTION (FROM AIR PIPELINE INLET ASSEMBLY)
ORC
N2O OFPD
TUBE CONNECTION (FROM N2O PIPELINE INLET ASSEMBLY)
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Figure 4-6. OFPD Replacement

4.6.12 Air OFPD: Reinstall the copper air line between the Air OFPD and the air pipeline inlet assembly.

N_2O OFPD: Reinstall the copper N_2O line between the N_2O OFPD and the N_2O pipeline inlet assembly.

4.6.13 Reinstall the flowmeter housing back cover.

4.6.14 Perform the PMC Procedure given in Section 6.

4.7 Oxygen Supply Pressure Alarm Switch

The oxygen supply low pressure alarm switch is located inside the flowmeter housing, attached to a bracket on the flowmeter sub-assembly. Access to the switch requires removal of the flowmeter housing back cover. Figure 4-7 shows the pneumatic and electrical connections to the switch.

4.7.1 Turn the System Power switch to STANDBY and disconnect the pipeline hoses.

4.7.2 Remove the flowmeter housing back cover. Be sure to disconnect the ventilator exhaust hose.

4.7.3 Separate the in-line connector on the switch wire harness.

4.7.4 Remove the press-on hose clamp and disconnect the tubing from the hose barb on the bottom of the switch.

4.7.5 Loosen the four screws holding the switch to the bracket; lift out the switch and screws.

4.7.6 Transfer the screws to the replacement switch; position the switch on the bracket, and tighten the four screws to secure the switch to the bracket.

4.7.7 Reconnect the tubing to the hose barb on the switch and secure it with the press-on clamp.

4.7.8 Join the in-line connector to its corresponding wire harness.

4.7.9 Perform the oxygen supply pressure alarm switch adjustment procedure given in Section 5 of this manual.

4.7.10 Reinstall the flowmeter housing back cover.

4.7.11 Perform the PMC procedure given in Section 6.

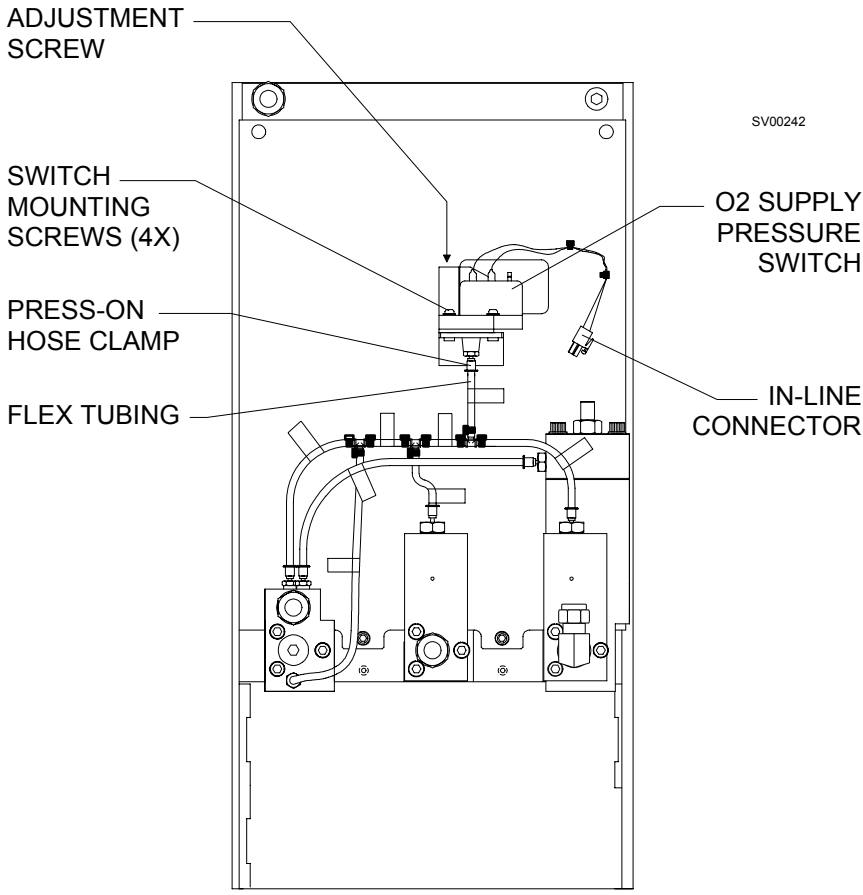

Figure 4-7. Oxygen Supply Pressure Alarm Switch

4.8 O2 - Air Switch

The ventilator drive gas (O_2 - Air) selector is a manually operated pneumatic switch located at the opening at the side of the flowmeter housing. The switch is attached to a bracket fixed to the inside wall of the flowmeter housing. The switch handle is within a recess housing that is attached to the switch by a panel nut. Access to the switch requires removal of the flowmeter housing back cover. Figure 4-8 shows the mounting arrangement and connections.

4.8.1 Disconnect all pipeline hoses and turn the System Power switch to ON.

4.8.2 Open the oxygen cylinder valve.

4.8.3 Set the oxygen flow to 5 liters per min.

4.8.4 Open the other gas flow control valves to drain pressure from the system.

4.8.5 Close the O_2 cylinder valve and the O_2 flow control valve. Press the O_2 Flush valve to drain oxygen pressure from the system.

4.8.6 Turn the System Power switch to STANDBY.

4.8.7 Disconnect the copper tube at the upper port of the Air pipeline inlet assembly (marked **A** in the illustration).

4.8.8 Disconnect the copper tube (O_2) from the O_2 port at the switch.

4.8.9 Remove the two screws securing the switch bracket.

4.8.10 In the recess housing, remove the panel nut and lock washer from the switch.

4.8.11 Pull the switch out far enough to gain access to the output port; disconnect the flex tubing and remove the switch from the flowmeter housing.

4.8.12 Remove the copper tube (Air) from the switch, and transfer it to the replacement switch.

4.8.13 Transfer the recess housing (around the switch handle) to the replacement switch.

4.8.14 Place the switch bracket over the switch and position the replacement switch in the flowmeter housing. Reconnect the flex tubing to the output port on the switch.

4.8.15 Reinstall the bracket screws that were previously removed.

4.8.16 Connect the O_2 copper tube to the O_2 port on the switch.

4.8.17 Connect the Air copper tube to the upper port of the Air pipeline inlet assembly. Tighten all copper tube compression fittings.

4.8.18 Reinstall the flowmeter housing back cover.

4.8.19 Perform the PMC Procedure given in Section 6.

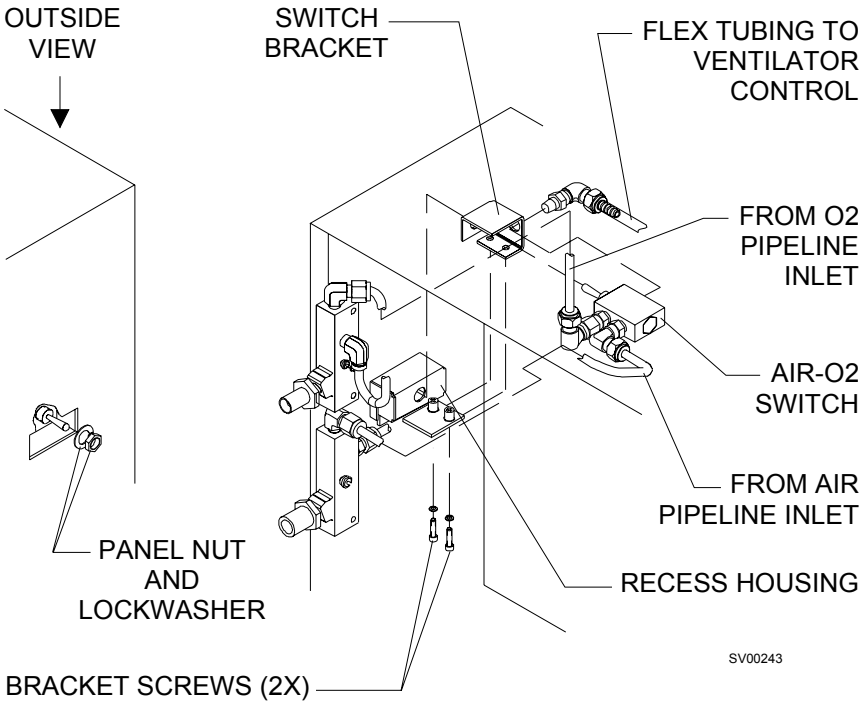

Figure 4-8. O2 - Air Switch

4.9 System Power Switch

The system power switch assembly is located in the power supply housing. Access to the switch assembly requires removal of the power supply from its housing. Figure 4-9 shows the connection and mounting arrangement for the switch assembly.

4.9.1 Disconnect all pipeline hoses and turn the System Power switch to ON.

4.9.2 Close the O_2 cylinder valve and the O_2 flow control valve. Press the O_2 Flush valve to drain oxygen pressure from the system.

4.9.3 Disconnect the AC power cord and remove the following items from the machine: oxygen cylinder, vaporizer, display.

4.9.4 Separate the machine from its support frame and carefully place it upside-down on a suitable surface.

4.9.5 Remove the power supply assembly as outlined in Paragraph 4.16 of this section.

4.9.6 Disconnect the tubing at the three compression fittings on the switch assembly.

4.9.7 Locate the 2-pin in-line connector that joins the switch wires to the main harness (orange and violet wires).

Separate this in-line connector.

4.9.8 Release the two switch wire pins from the connector body, and retrieve the switch wires through the bulkhead bushing.

4.9.9 Remove the two screws securing the switch assembly to the power supply housing, and remove the switch assembly from the housing.

4.9.10 Install the replacement switch assembly in the power supply housing and secure it with the hardware that was previously removed.

4.9.11 Route the switch wires through the bulkhead bushing in the same manner as the original, and install the pins in the connector body: violet wire in Position #1, orange wire in Position #2.

4.9.12 Join the in-line connector.

4.9.13 Re-connect the tubing to the compression fittings on the replacement switch assembly.

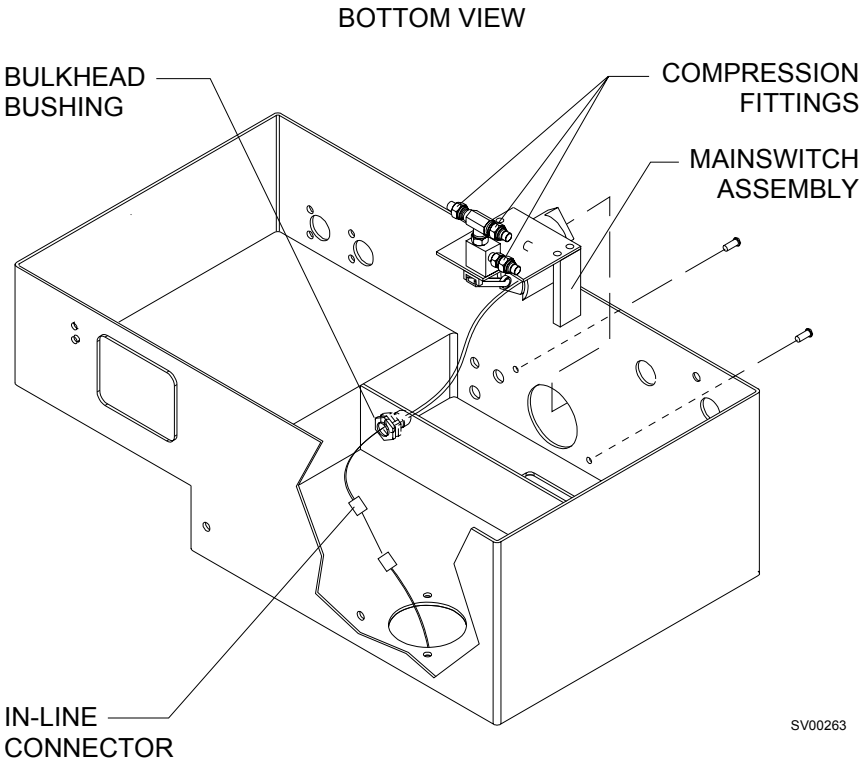

Figure 4-9. System Power Switch

4.9.14 Reinstall the power supply assembly as outlined in Paragraph 4.16 of this section.

4.9.15 Reattach the machine to its support frame.

4.9.16 Reinstall the display, vaporizer, and oxygen cylinder.

4.9.17 Reconnect the pipeline supplies.

4.9.18 Restore AC power to the machine and ensure that new system power switch is working properly.

4.9.19 Perform the PMC Procedure given in Section 6.

4.10 Oxygen Ratio Controller

The Oxygen Ratio Controller (ORC) is part of the N_2O flowmeter sub-assembly and is located within the flowmeter housing. Access to the ORC requires removal of the flowmeter housing back cover, and removal of the N_2O OFPD assembly. Figure 4-10 shows the ORC location and mounting arrangement.

4.10.1 Disconnect all pipeline hoses and turn the System Power switch to ON.

4.10.2 Open the oxygen cylinder valve.

4.10.3 Set the oxygen flow to 5 liters per min.

4.10.4 Open the other gas flow control valves to drain pressure from the system.

4.10.5 Close the O_2 cylinder valve and the O_2 flow control valve. Press the O_2 Flush valve to drain oxygen pressure from the system.

4.10.6 Turn the System Power switch to STANDBY.

4.10.7 Remove the flowmeter housing back cover.

4.10.8 Remove the copper N_2O line between the N_2O OFPD and the N_2O pipeline inlet assembly.

4.10.9 Remove the press-on hose clamp and disconnect the small diameter tubing from the hose barb at the top of the OFPD.

4.10.10 Remove the press-on hose clamp and disconnect the small diameter tubing from the hose barb on the side of the ORC.

NOTE: The N_2O OFPD has long mounting screws, which pass through the oxygen ratio controller (ORC) and into the flowmeter sub-assembly. These screws retain both devices.

4.10.11 Remove the three screws securing the OFPD and the ORC, and remove the OFPD and ORC.

4.10.12 Position the replacement ORC at the back of the N_2O flowmeter sub-assembly; be sure that its O-rings and filter are in place. Reinstall the OFPD, with the mounting screws going through the ORC and into the flowmeter sub-assembly. Tighten the screws.

4.10.13 Reconnect the small diameter tubing to the ORC and secure the connection with the press-on hose clamp.

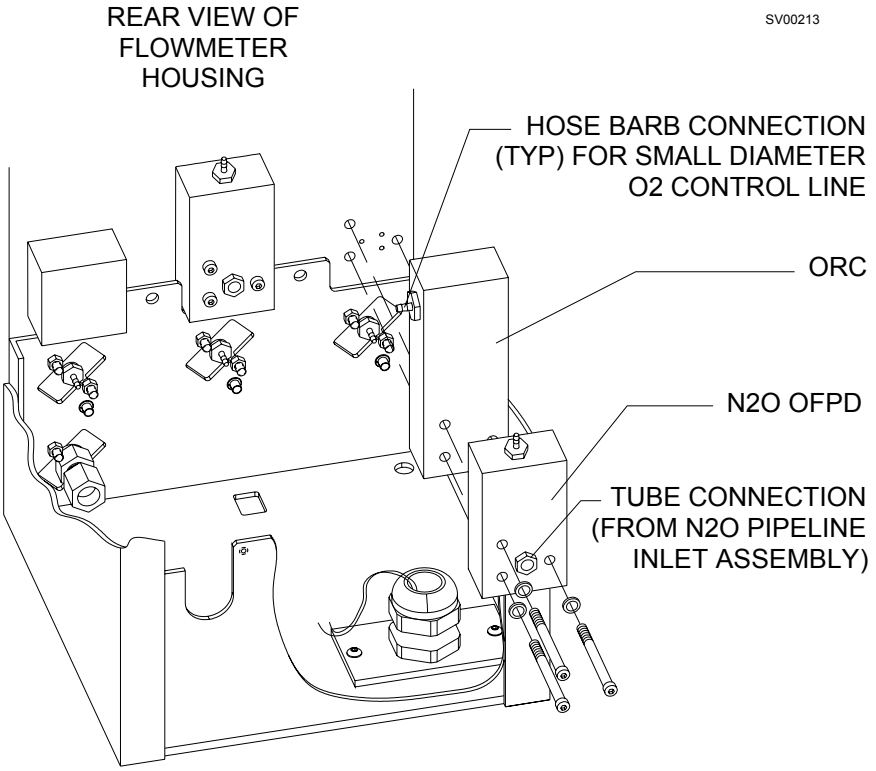

Figure 4-10. Oxygen Ratio Controller

4.10.14 Reconnect the small diameter tubing to the hose barb on the OFPD and secure the connection with the press-on hose clamp.

4.10.15 Reinstall the copper N_2O line between the N_2O OFPD and the N_2O pipeline inlet assembly.

4.10.16 Connect the pipeline supplies.

4.10.17 Perform the ORC adjustment procedure given in Section 5 of this manual.

4.10.18 Reinstall the flowmeter housing rear cover.

4.10.19 Perform the PMC Procedure given in Section 6.

4.11 O2 Flush Valve

The O_2 flush valve is located at the front of the machine next to the fresh gas outlet. Access to the flush valve is through the bottom of the machine, which requires removal of the power supply assembly. It is recommended that all accessories be removed from the machine, and the machine removed from its support frame. Figure 4-11 shows the mounting arrangement of the O_2 flush valve and its tubing connections.

4.11.1 Turn the System Power switch to STANDBY and remove AC power from the machine.

4.11.2 Disconnect all pipeline supplies; close the oxygen cylinder valve and remove the cylinder.

4.11.3 Remove the power supply assembly from the machine: refer to the power supply replacement procedure elsewhere in this section.

4.11.4 Press the O_2 Flush valve to drain pressure from the system.

4.11.5 Disconnect breathing and scavenger hoses, and sensor interface connections.

4.11.6 Disconnect the fresh gas hose and remove the absorber assembly from the machine.

4.11.7 Remove the vaporizer from the machine; ensure that its handwheel is locked in the "T" (transport) position.

4.11.8 Loosen the four wing screws securing the anesthesia machine to the support frame, and carefully lift the machine from the frame.

4.11.9 Carefully lay the machine on its side in a suitable work area, for access to the flush valve.

4.11.10 Hold the O_2 Flush button in and rotate it until one of its set screws are visible through an access hole in the guard ring, and loosen the set screw.

4.11.11 Turn the O_2 Flush button 180 degrees, hold it in and loosen the other set screw.

4.11.12 Remove the O_2 Flush button and washer from the valve shaft.

4.11.13 Disconnect the compression fittings at the valve.

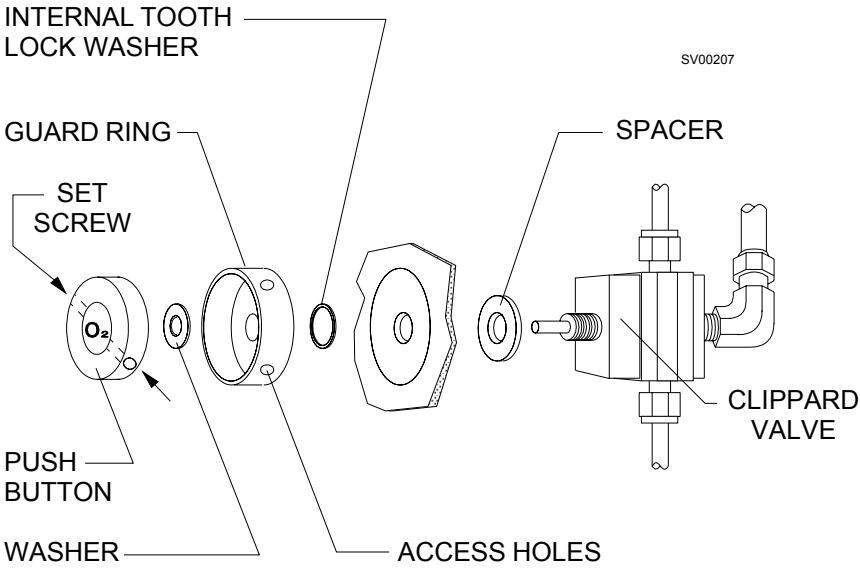

Figure 4-11. O_2 Flush Valve

4.11.14 The O_2 Flush valve is retained by the guard ring on the front of the machine. Hold the body of the Clippard valve with an open end wrench; insert a rod or hex wrench through the holes in the guard ring (or use a spanner wrench), and un-screw the guard ring.

4.11.15 Assemble the replacement O_2 Flush valve, spacer, internal tooth lock washer and guard ring through the chassis and tighten the assembly, making sure that the valve is mounted straight.

4.11.16 Connect the compression fittings to the valve.

4.11.17 Place the washer and the O_2 Flush button on the valve shaft.

4.11.18 Hold the O_2 Flush button in and turn it until a set screw is visible through an access hole in the guard ring. Tighten the set screw. Rotate the button 180 degrees until the other set screw is visible, and tighten the set screw.

4.11.19 Reinstall the anesthesia machine on the support frame.

4.11.20 Reinstall the power supply assembly in the machine: refer to the power supply replacement procedure elsewhere in this section.

4.11.21 Reinstall all accessories that were previously removed; restore all breathing, scavenger and sensor interface connections. Refer to the Installation Instructions in the *Narkomed M Operator's Manual*.

4.11.22 Connect a test gauge and B.P. bulb to the fresh gas outlet, and perform the following test:

4.11.22.1 Open the oxygen cylinder valve and allow the pressure to stabilize. (The cylinder pressure must be at least 1000 psi for this test.)

4.11.22.2 Release any pressure that is indicated on the test gauge.

4.11.22.3 Over the next 60 seconds, the test gauge should not show a pressure increase greater than 2 cm H_2O.

4.11.22.4 Increase the pressure to 50 cm H_2O.

4.11.22.5 The pressure should not drop more than 10 cm H_2O in the next 30 seconds.

4.11.22.6 Disconnect the test gauge from the fresh gas outlet.

4.11.22.7 Close the oxygen cylinder valve.

4.11.22.8 The pressure should not drop more than 50 psi in two minutes.

4.11.22.9 Connect a volumeter to the fresh gas outlet, and reset the volumeter to zero.

4.11.22.10 Press the O_2 Flush button and observe the flow rate. It should be between 45 and 65 liters per minute.

4.11.22.11 Disconnect the volumeter from the fresh gas outlet.

4.11.23 Connect the absorber fresh gas hose to the fresh gas outlet.

4.11.24 Connect the pipeline hoses.

4.11.25 Perform the PMC Procedure given in Section 6.

4.12 Ventilator Controller (Bezel Assembly)

The ventilator controller assembly is attached to the inner shelf above the flowmeter housing and bellows box. Figure 4-12 shows the mounting screw locations, pneumatic and electrical connections to the ventilator controller.

4.12.1 Turn the System Power switch to STANDBY and remove AC power from the machine.

4.12.2 Disconnect all pipeline hoses and close the O_2 cylinder valves.

CAUTION: The controller circuit board contains static sensitive devices. Use ESD protection when handling the controller assembly. Static discharge can damage components on the circuit board.

4.12.3 Remove the flowmeter housing back cover. Be sure to disconnect the ventilator exhaust hose.

4.12.4 Remove the two screws holding the ventilator controller chassis to the inside shelf; remove the two screws holding the hex standoffs attached to the controller assembly. You will need to open the battery compartment and remove the battery for access to one of the screws.

4.12.5 Pull the assembly out from the front of the machine far enough to gain access to its connections.

4.12.6 Disconnect tube **D** from the fitting at the bottom of the inspiratory flow regulator.

4.12.7 Disconnect the power wiring harness from J2 on the controller circuit board.

4.12.8 Disconnect the switch and solenoid wiring harness from J1 on the controller circuit board.

4.12.9 Disconnect tube **B** from the fitting at the diaphragm valve.

4.12.10 Disconnect small diameter tubes **A** and **C**, and remove the controller assembly from the machine.

4.12.11 Position the replacement controller assembly at the front of the ventilator box and reconnect the four pneumatic lines.

4.12.12 Reconnect wire harnesses to J1 and J2 on the controller circuit board.

4.12.13 Slide the controller into the ventilator box until it is properly seated.

4.12.14 Reinstall the two screws to secure the controller chassis to the shelf.

4.12.15 Reinstall the two screws holding the hex standoffs, and reinstall the battery.

4.12.16 Reconnect the ventilator exhaust hose and reinstall the flowmeter housing back cover.

4.12.17 Perform the PMC Procedure given in Section 6.

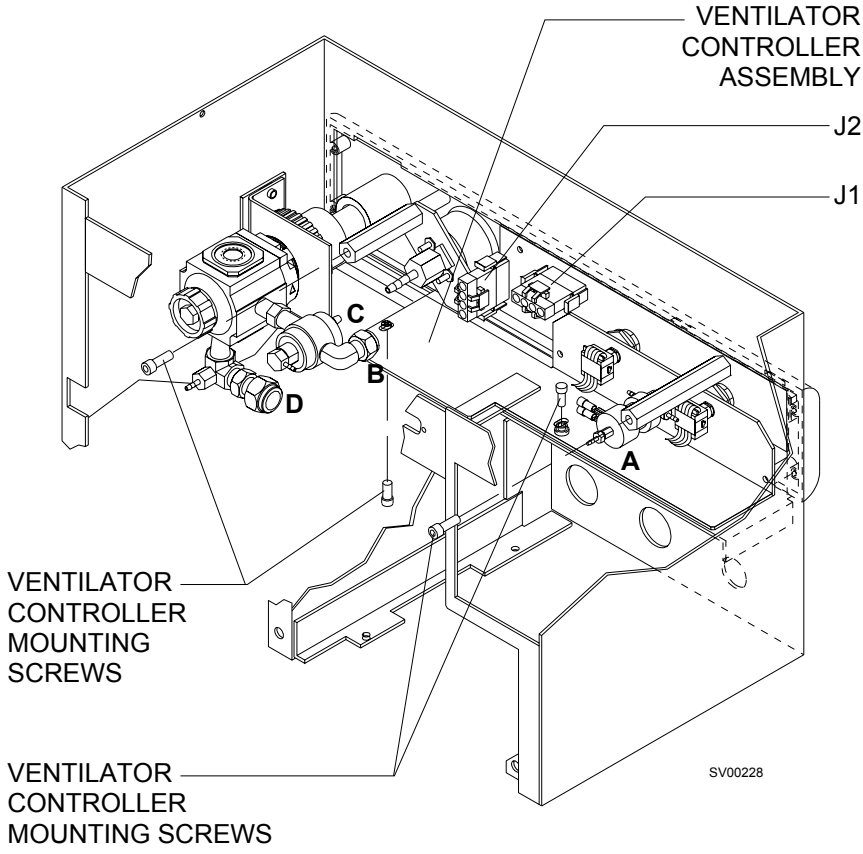

Figure 4-12. Ventilator Controller (Bezel Assembly)

4.13 Bellows Valve Assembly

The bellows valve assembly is located in the bellows box directly above the bellows canister. Access to the valve assembly requires removal of the flowmeter housing back cover (which also covers the bellows box). Figure 4-13 shows the pneumatic connections and mounting arrangement of the valve assembly.

4.13.1 Turn the System Power switch to STANDBY and remove AC power from the machine.

4.13.2 Remove the flowmeter housing back cover.

4.13.3 Adjust the TIDAL VOLUME control to raise the volume indicator to its maximum setting.

4.13.4 Disconnect the breathing hose and the scavenger hose from the bellows assembly. Loosen the wing nuts and remove the bellows assembly.

4.13.5 Remove the canister from the bellows box by pulling it downward. (It is a press-fit.)

4.13.6 Disconnect tube **B** from the venturi, and tube **C** from the auto-ranging valve.

4.13.7 Remove the four screws securing the valve assembly to the bellows box.

4.13.8 Pull the valve assembly toward the back of the machine until the bottom plate of the assembly is able to drop down through the cutouts in the bottom lip on each side of the bellows box.

4.13.9 Install the replacement valve assembly - slide the assembly up into the bellows box and forward into position. (It may be necessary to rotate the pressure limit and tidal volume knobs until their drive slots are aligned with the shaft pins, in order to move the valve assembly into its correct position.)

4.13.10 Secure the valve assembly to the bellows box with the hardware that was previously removed.

4.13.11 Reconnect the tubing to the venturi, and the auto-ranging valve.

4.13.12 Reinstall the canister in the bellows box. Ensure that the markings are facing forward.

4.13.13 Reinstall the bellows assembly and tighten the wing nuts.

4.13.14 Reconnect the breathing and scavenger hoses to the bellows assembly.

4.13.15 Reinstall the flowmeter housing back cover.

4.13.16 Perform the PMC Procedure given in Section 6.

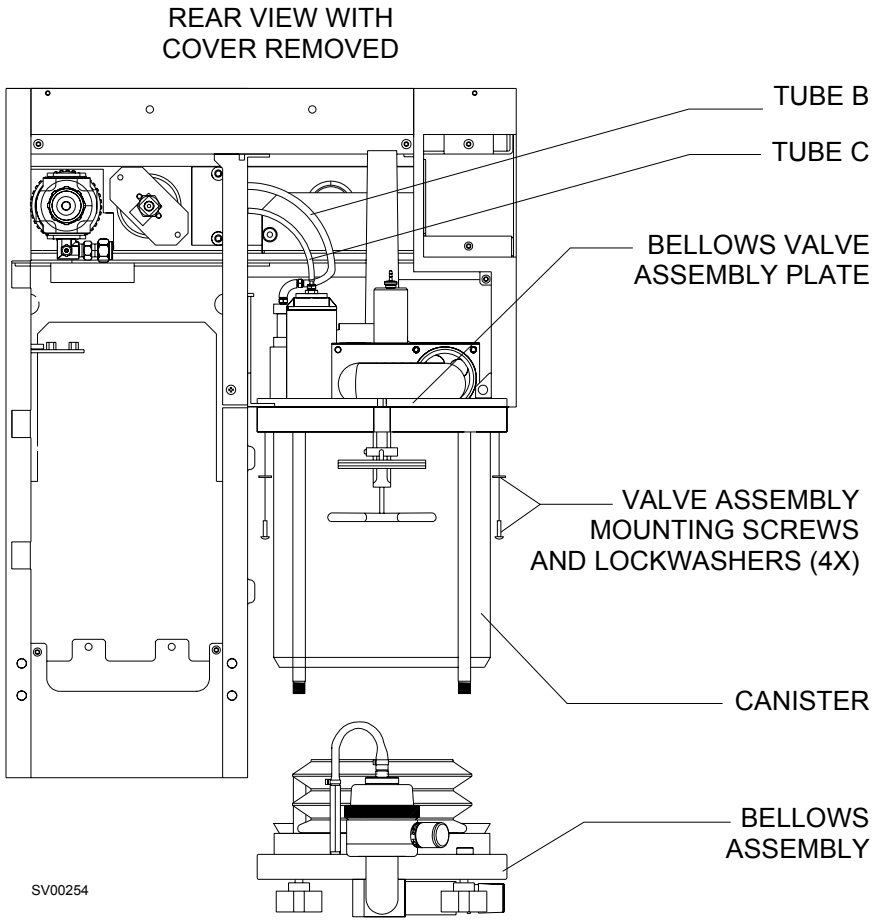

Figure 4-13. Bellows Valve Assembly

4.14 Caster Replacement

Each caster is threaded into a leg of the support frame. A typical arrangement is shown in Figure 4-14. It is recommended that the anesthesia machine and its accessories be removed from the support frame before replacing the casters.

4.14.1 Turn the System Power switch to STANDBY and remove AC power from the machine.

4.14.2 Disconnect all pipeline supplies; close the oxygen cylinder valve and remove the cylinder.

4.14.3 Disconnect breathing and scavenger hoses, and sensor interface connections.

4.14.4 Disconnect the fresh gas hose and remove the absorber assembly from the machine.

4.14.5 Remove the vaporizer from the machine; ensure that its handwheel is locked in the "T" (transport) position.

4.14.6 Loosen the four wing screws securing the anesthesia machine to the support frame, and carefully lift the machine from the frame.

4.14.7 Unscrew the caster to be replaced (counter-clockwise, viewed from the bottom) using a caster wrench P/N S010055.

NOTE: Caster part numbers are:

- Front: 4113874-003 (with brake)
- Back: 4113874-004 (without brake)

4.14.8 Apply an ample amount of Loctite #242 to the stem of the replacement caster, and thread the stem of the replacement caster (clockwise, viewed from the bottom) into the leg of the support frame. Do not over-tighten. Ensure that all casters freely roll and swivel.

4.14.9 Lock the front casters, and reinstall the anesthesia machine on the support frame.

4.14.10 Reinstall all accessories that were previously removed; restore all breathing, scavenger, fresh gas and sensor interface connections. Refer to the Installation Instructions in the *Narkomed M Operator's Manual.*

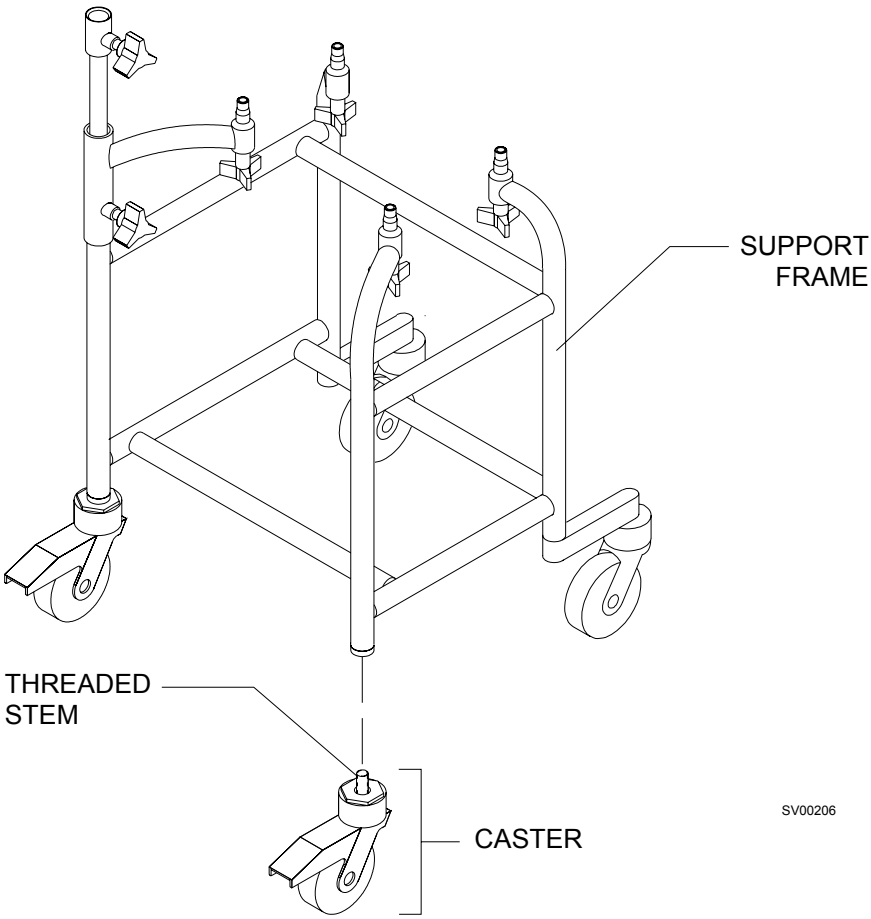

Figure 4-14. Caster Replacement

4.15 Battery Replacement

The battery is located in a compartment accessible at the back of the bellows box. Figure 4-15 shows the battery compartment door and battery wiring arrangement. The battery is removed from its compartment when the machine is stored in its transit case, and is reinstalled when the machine is prepared for use.

4.15.1 Turn the System Power switch to STANDBY and remove AC power from the machine.

4.15.2 Unscrew the two captive mounting screws on the battery compartment door, and remove the door.

4.15.3 Pull the battery from its compartment and separate the in-line wire harness connector.

4.15.4 Connect the replacement battery to the in-line connector, and install the battery in the battery compartment in the same manner as the original.

4.15.5 Reinstall the battery compartment door and secure it with the two captive mounting screws.

4.15.6 Restore AC power to the machine to allow the battery to charge. Allow 12 hours charging time for a fully discharged battery.

End of life battery disposal:

Dispose of the spent rechargeable, sealed lead-acid battery in conformance with local waste disposal regulations.

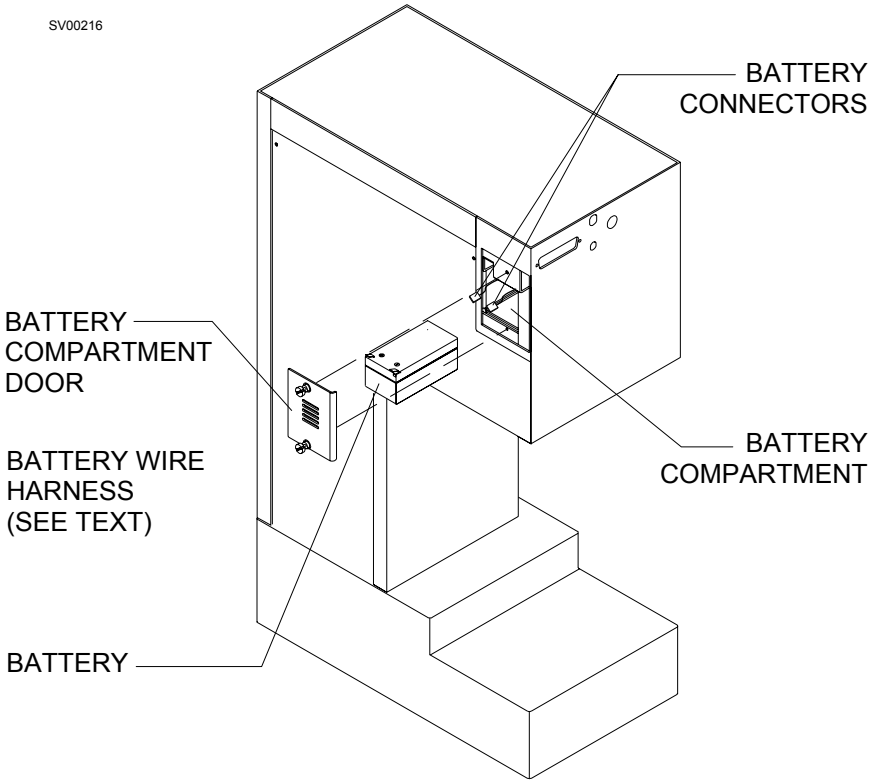

Figure 4-15. Battery Replacement

4.16 Power Supply Assembly

The power supply assembly comprises the power inlet connector, circuit breakers, primary power supply and regulator PCB. It is field serviced by replacing the complete assembly. Figure 4-16 shows the mounting arrangement and electrical connections.

4.16.1 Disconnect all pipeline hoses and turn the System Power switch to ON.

4.16.2 Close the oxygen cylinder valve, and press the O_2 Flush button to drain oxygen pressure from the system.

WARNING: Ensure that AC power is removed from the machine before removing the power supply. Failure to observe this precaution may cause injury by electric shock.

4.16.3 Turn the System Power switch to STANDBY and disconnect the AC power cord from the power inlet on the back of the machine.

4.16.4 Disable the circuit breakers by pulling out each button with a knife or sharp object.

4.16.5 Remove the following items from the machine: oxygen cylinder, vaporizer, display.

4.16.6 Separate the machine from its support frame and carefully place it upside-down on a suitable surface.

4.16.7 Remove the six screws holding the power supply assembly to the housing, and lift out the assembly far enough for access to its cables.

4.16.8 Carefully disconnect the following from the PCB on the assembly:

Output wire harness from J1
14 cond. ribbon cable from J2
Battery wire harness from J6
Power applied lamp from J5

4.16.9 Reconnect the cables and wire harnesses to J1, J2, J6, and J5 on the replacement power supply assembly.

4.16.10 Position the power supply assembly in the housing and secure it with the six mounting screws throughthe bottom of the power supply.

4.16.11 Reattach the machine to its support frame.

4.16.12 Reinstall the display, vaporizer, and oxygen cylinder.

4.16.13 Enable the circuit breakers by pushing in each button.

4.16.14 Reconnect the AC power cord.

4.16.15 Perform the PMC procedure given in Section 6.

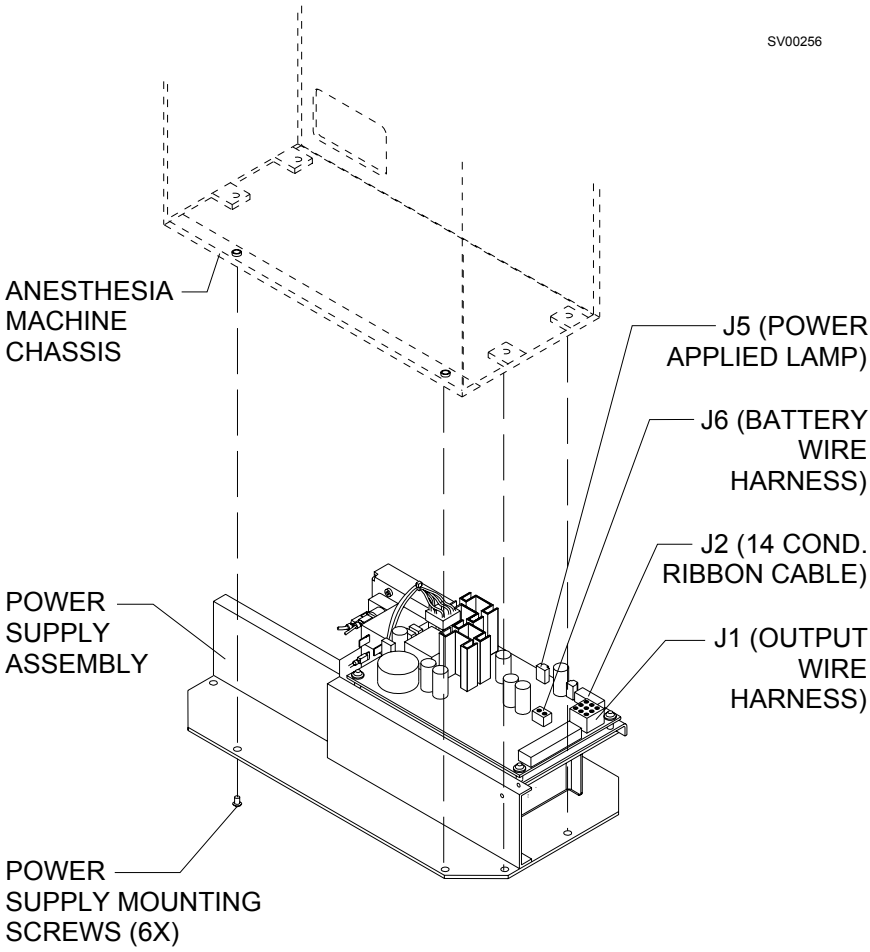

Figure 4-16. Power Supply Assembly Replacement

4.17 Processor Assembly

Access to the processor assembly requires removal of the top cover from the monitor housing. Figure 4-17 shows the processor mounting arrangement and location of cables that must be disconnected.

4.17.1 Turn the System Power switch to STANDBY and remove AC power from the machine.

4.17.2 Remove the screws securing the top cover of the monitor housing. Lift the cover and disconnect its ground wire.

CAUTION: The processor board contains static sensitive devices. Use ESD protection when handling the processor assembly. Static discharge can damage components on the circuit board.

4.17.3 Disconnect the following items from their connectors on the processor board:

J105:	30 psi switch	J12:	Speaker
J4:	Keypad cable	J204:	Display cable
J102:	Spiromed interface	J103:	O_2 Sensor interface
J14:	Power supply wire harness	J18:	Serial port

Tubing connection to breathing pressure transducer

4.17.4 Remove the screws securing the processor assembly to the monitor housing, and lift out the processor assembly.

4.17.5 Inspect the jumper on JP6 (top PCB) on the replacement processor assembly and ensure it is installed on both pins of JP6 before installing the processor assembly. This jumper is not placed on both pins of JP6 in order to prevent backup battery drain while the processor assembly is in stock.

NOTE: On later design boards this jumper is at JP2 (see illustration).

4.17.6 Install the replacement processor using the hardware that was removed in the previous step.

4.17.7 Reconnect the pneumatic tubing and cables that were previously disconnected.

4.17.8 Reconnect the ground wire, and reinstall the monitor housing top cover.

4.17.9 Restore power to the machine and observe the Power-Up Diagnostic display (see Section 2) to verify that the replacement processor is working properly.

4.17.10 Perform the PMC Procedure given in Section 6.

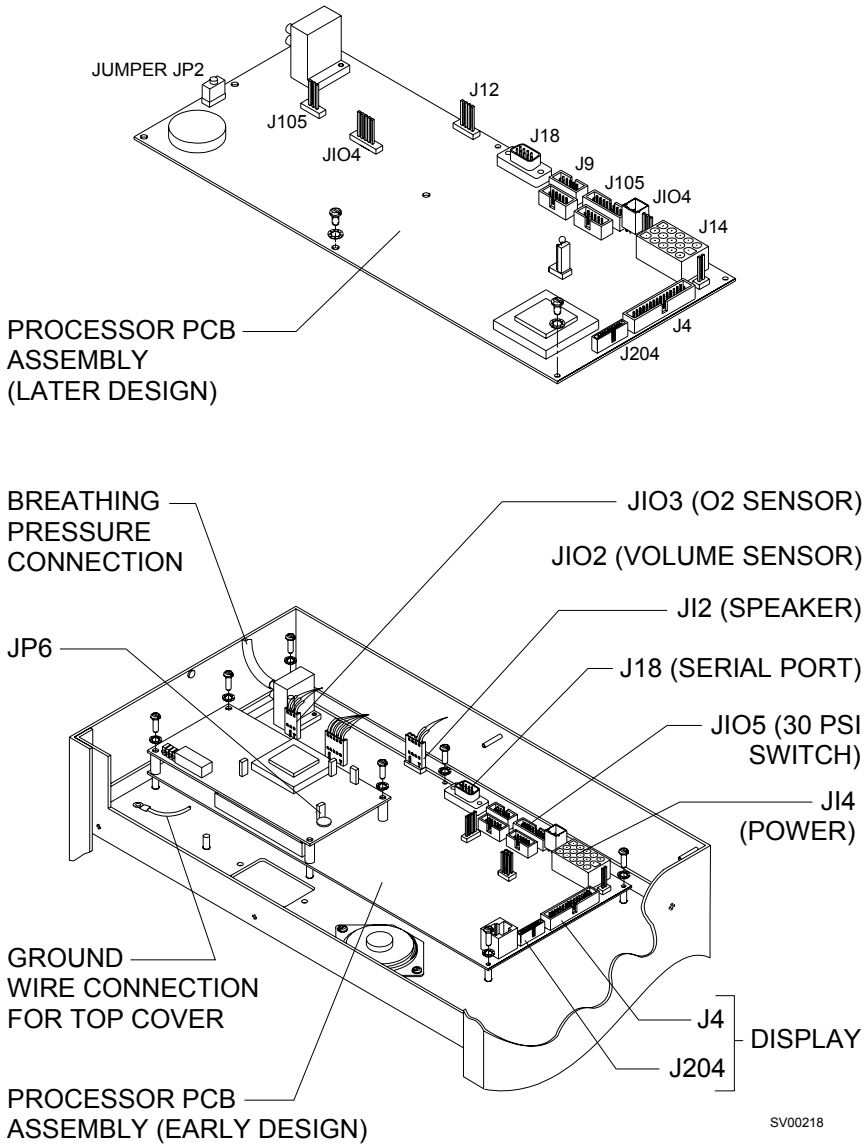

Figure 4-17. Processor Assembly

4.18 Display Assembly

The display assembly comprises the keypad & display panel, its housing, cable, and mounting rod. The display assembly is attached to the joint assembly (remote bar and monitor support arm) by a screw as shown in Figure 4-18.

4.18.1 Turn the System Power switch to STANDBY.

4.18.2 Unplug the display cable from its port on the side of the machine.

4.18.3 Remove the display assembly retainer screw from the joint assembly (support arm) and lift out the display assembly.

4.18.4 Install the replacement display assembly in the support arm; reinstall and tighten the display assembly retainer screw.

4.18.5 Connect the display cable to its port on the side of the machine.

4.18.6 Power up the machine and observe the display for correct operation; exercise all of the keypad functions to verify their operation.

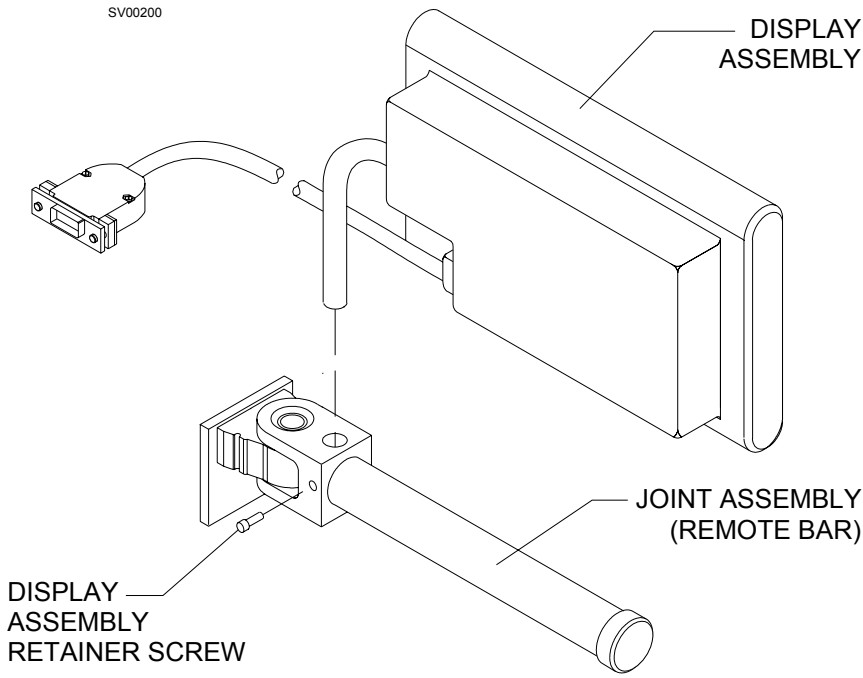

Figure 4-18. Display Assembly

4.19 Breathing Pressure Hose Assembly

The breathing pressure hose assembly consists of a pressure sensor adapter with two hoses attached, each with a quick-connect fitting at the outboard end. The longer hose connects to the breathing pressure interface panel on the monitor housing. The pressure sensor adapter is inserted between the inspiratory valve dome and the oxygen sensor housing as shown in Figure 4-19. The shorter hose connects to a port near the breathing pressure gauge on the absorber assembly.

Removal:

4.19.1 Turn the System Power switch to STANDBY.

4.19.2 Disconnect the hose fittings from the interface panel, and the absorber.

4.19.3 Pull the oxygen sensor housing from the pressure sensor adapter (it is a press fit).

4.19.4 Pull the pressure sensor adapter from the absorber top dome (it is a press fit).

Installation:

4.19.5 Insert the pressure sensor adapter into the absorber top dome.

4.19.6 Insert the oxygen sensor housing into the pressure sensor adapter.

4.19.7 Connect the short hose to the fitting on the absorber assembly.

4.19.8 Connect the longer hose to the breathing pressure interface panel.

4.19.9 Restore power to the machine and perform the pressure monitor diagnostic test given in Section 2 to verify operation of the system.

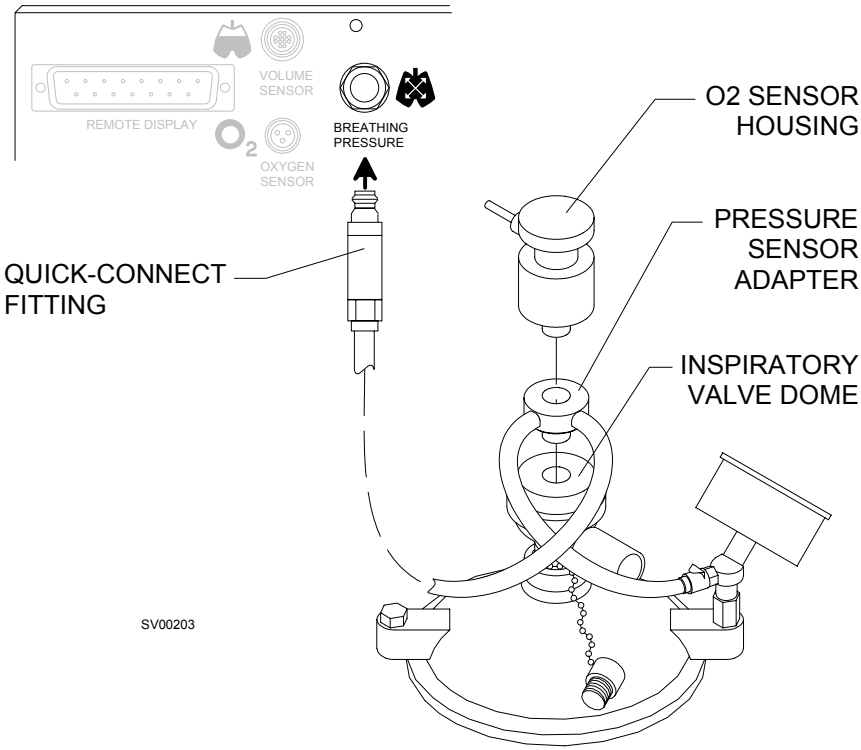

Figure 4-19. Breathing Pressure Hose Assembly

4.20 Manual/Automatic Selector Valve

The manual/automatic selector valve is part of the absorber assembly, and is fixed to the absorber flange with three screws. Figure 4-20 shows the components that are mounted on the valve, and the attaching hardware at the absorber flange.

4.20.1 Turn the System Power switch to STANDBY.

4.20.2 Disconnect the ventilator hose from the rear 22 mm terminal on the selector valve, and remove the terminal.

4.20.3 Disconnect the bag hose from the bottom 22 mm terminal on the selector valve, and remove the terminal.

4.20.4 Disconnect the scavenger hose from the 19 mm terminal on the APL valve.

4.20.5 Loosen the locking ring on the APL valve with a spanner wrench (P/N S010058), and unscrew (counter-clockwise, viewed from the top) the APL valve from the manual/automatic selector valve.

4.20.6 Remove the three screws securing the selector valve to the absorber flange, and remove the valve.

4.20.7 Ensure that the O-ring at the absorber flange is in good condition, and attach the replacement manual/automatic selector valve to the absorber flange using the three screws and lock washers that were previously removed.

4.20.8 Reinstall the APL valve: Ensure that the fiber washer is in place, and screw the valve in to its desired position. Tighten the locking ring with the spanner wrench.

4.20.9 Reinstall the 22 mm hose terminals on the selector valve; ensure that their O-rings are in good condition.

4.20.10 Re-connect the ventilator hose to the rear 22 mm terminal, and re-connect the bag hose to the bottom 22 mm terminal.

4.20.11 Re-connect the scavenger hose to the 19 mm terminal on the APL valve.

4.20.12 Perform the PMC Procedure given in Section 6.

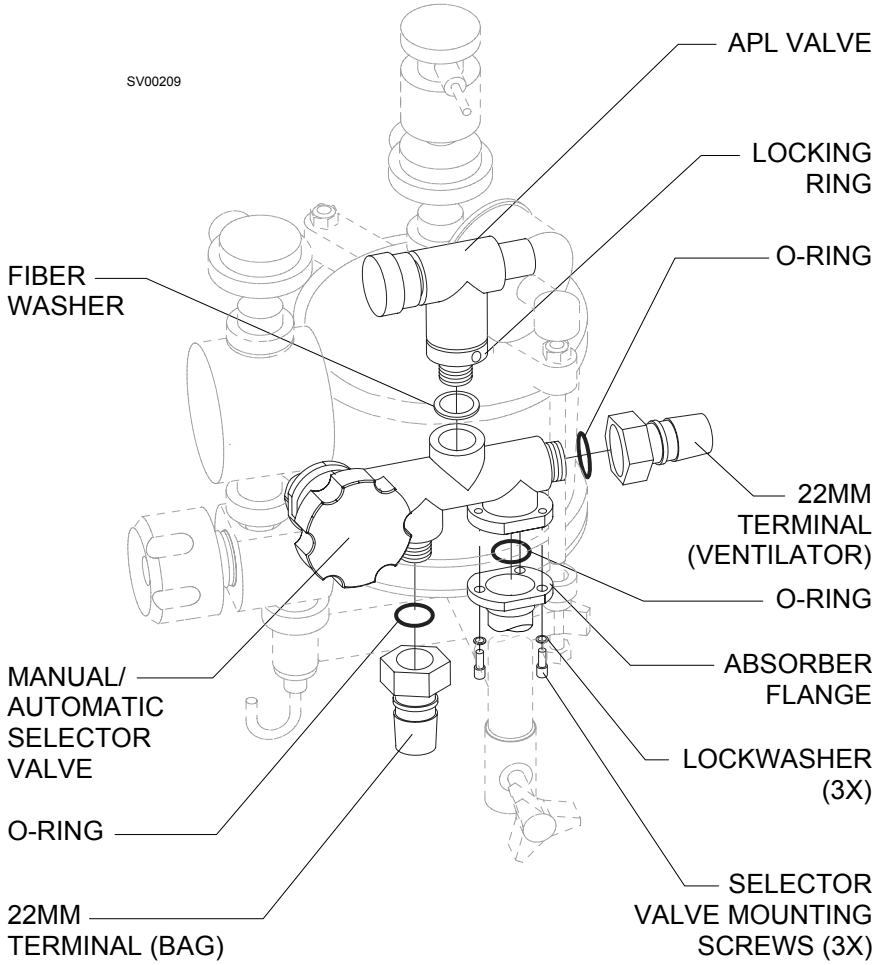

Figure 4-20. Manual/Automatic Selector Valve

4.21 Spiromed Sensor

The respiratory volume sensor is installed between the lower absorber pipe and the PEEP valve. Figure 4-21 shows the volume sensor mounting and gasket arrangement, and its interface cable connection on the side of the monitor housing.

4.21.1 Turn the System Power switch to STANDBY.

4.21.2 Disconnect the sensor plug from the volume sensor interface panel on the monitor housing.

4.21.3 Remove the PEEP valve by unscrewing the valve retaining nut.

4.21.4 Remove the volume sensor from the lower absorber pipe by unscrewing its retaining nut.

CAUTION: Do not twist the body of the Spiromed sensor when loosening the retaining nut. Hold the sensor while loosening the retaining nut to prevent damage to the sensor.

4.21.5 Install the replacement volume sensor on the lower absorber pipe. Ensure that the gasket is seated properly and hand tighten the retaining nut.

4.21.6 Install the PEEP valve on the sensor. Ensure that the gasket is seated properly and hand tighten the valve retaining nut.

4.21.7 Connect the sensor plug to the volume sensor interface panel on the monitor housing.

4.21.8 Restore power to the machine and perform the respiratory flow monitor calibration procedure given in Section 5.

4.21.9 Perform the PMC Procedure given in Section 6.

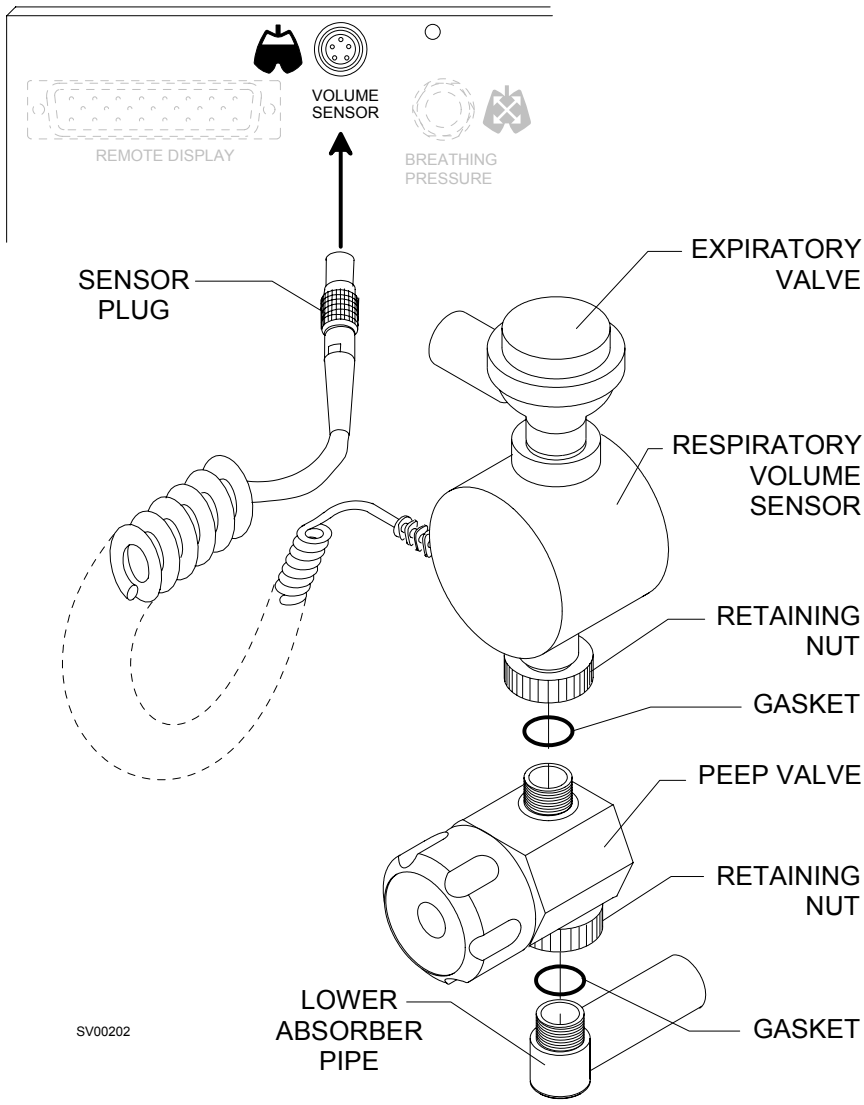

Figure 4-21. Respiratory Volume Sensor

4.22 Oxygen Sensor

The oxygen sensor is installed in the pressure sensor adapter on top of the inspiratory valve. Figure 4-22 shows the arrangement of the sensor capsule and its housing, and also its interface cable connection on the side of the monitor housing.

4.22.1 Turn the System Power switch to STANDBY.

4.22.2 Pull the oxygen sensor housing from the oxygen sensor adapter. (It is a press fit.)

4.22.3 Unscrew the cover from the sensor housing and remove the sensor capsule.

4.22.4 Remove the replacement sensor capsule from its shipping container and install it in the housing. Ensure that the copper rings on the capsule mate with the electrical contacts in the sensor housing.

4.22.5 Wait 15 minutes to allow the sensor capsule to stabilize.

4.22.6 Restore power to the machine and perform the Zero and the 21% calibration procedure for the oxygen monitor given in Section 5.

4.22.7 Insert the oxygen sensor assembly into the pressure sensor adapter.

4.22.8 Perform the PMC Procedure given in Section 6.

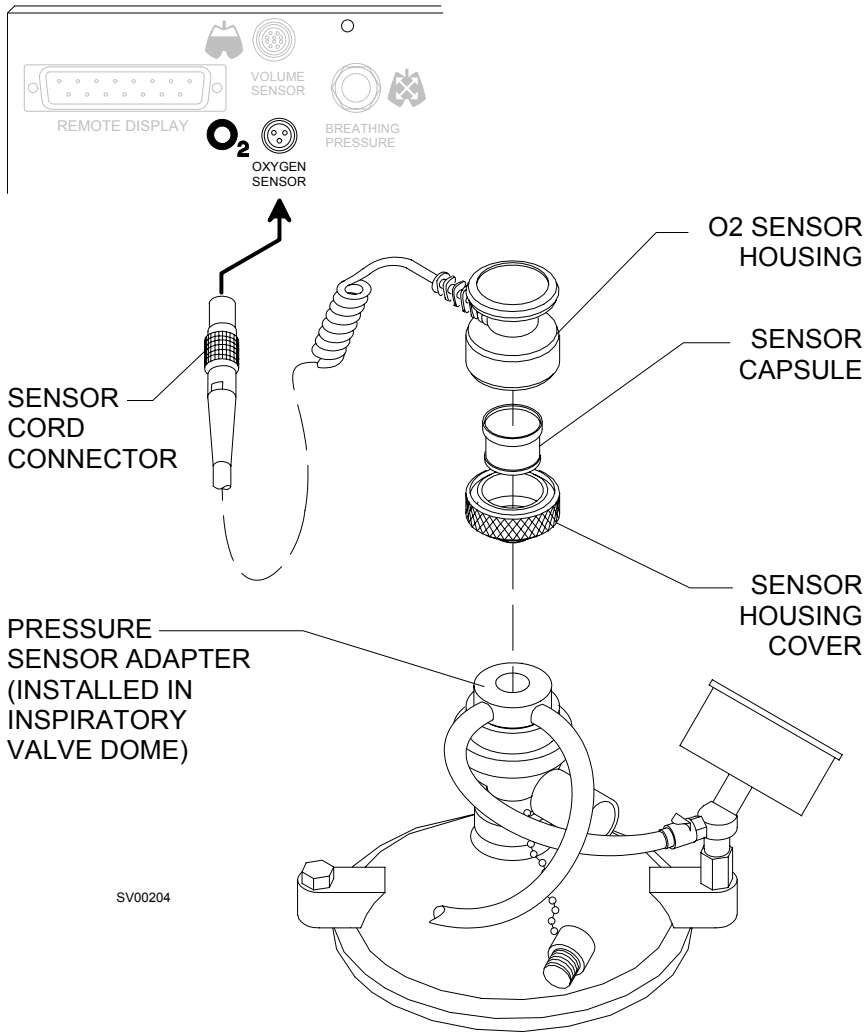

Figure 4-22. Oxygen Sensor

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5.0 Adjustment and Calibration Procedures

Equipment Required:

- Test Gauge for setting cylinder pressure regulator,

  NAD Part No. 4114807
- Oxygen Monitor for adjusting Oxygen Ratio Controller
- Test fixture with breathing pressure line connector, TEE connector, gauge, and inflation device, for breathing pressure monitor calibration

5.1 Cylinder Pressure Regulator Adjustment

5.1.1 Disconnect all pipeline hoses and turn the System Power switch to ON.

5.1.2 Open the oxygen cylinder valve.

5.1.3 Set the oxygen flow to 4 liters per min.

5.1.4 Open the other gas flow control valves to drain pressure from the system.

5.1.5 Close the O_2 cylinder valve, and close the flow control valves. Press the O_2 Flush valve to drain oxygen pressure from the system.

5.1.6 Turn the System Power switch to STANDBY.

5.1.7 Remove the flowmeter housing back cover.

5.1.8 Connect test pressure gauge (P/N 4114807) between machine's oxygen pipeline inlet connector and the oxygen pipeline supply hose.

5.1.9 Open the oxygen cylinder valve and turn the System Power switch to ON.

5.1.10 Set the oxygen flow to 4 liters per min.

5.1.11 Depress the push button on the test device.

5.1.12 Release the push button. After the pressure decay stabilizes, the gauge should indicate 46 psi.

5.1.13 Remove the acorn nut on the regulator to expose the adjusting screw. Make an adjustment, then repeat the previous two steps to obtain a reading. Repeat this process until 46 psi is obtained (50 psi for CSA machines). Use the compensated regulator output setting based on the cylinder pressure given in the following table.

CAUTION: Based on information supplied by the cylinder regulator manufacturer, when the regulator is used for O2 or Air, its output pressure will decrease 0.5 psi for every 100 psi increase in cylinder pressure above 1000 psi. Currently, these pressure regulators are calibrated at 47 psi with a cylinder supply of 1000 psi. If a 2000 psi cylinder is then installed, the regulator output will be 42 psi. This change in output must be compensated for to provide accurate performance throughout the cylinder's working range.

Cylinder Pressure (psi)	Compensated Regulator output setting (psi)	Compensated Regulator output tolerances (-4/+2)
2000	**42** (*45)	38 - 44 (*41 - 47)
1800	**43** (*46)	39 - 45 (*42 - 48)
1600	**44** (*47)	40 - 46 (*43 - 49)
1400	**45** (*48)	41 - 47 (*44 - 50)
1200	**46** (*49)	42 - 48 (*45 - 51)
1000	**47** (*50)	43 - 49 (*46 - 52)

* Canada settings

5.1.14 Verify the adjusted regulator maintains its compensated output tolerance.

5.1.15 If the O2 cylinder regulator output was adjusted, perform the following test:

5.1.15.1 Set the ventilator to Volume Mode ventilation.

5.1.15.2 Set the Auxiliary O2 and Fresh Gas O2 flows to 10 L/min.

5.1.15.3 Press the O2 Flush and verify the Lo O2 Supply alarm is not active. If the alarm is active refer to Section 5.2: Oxygen Supply Pressure Alarm Switch Adjustment.

5.1.16 Reinstall the acorn nut on the regulator.

5.1.17 Close the cylinder valve and allow pressure to drain from the system.

5.1.18 Close all of the flow control valves and set the System Power switch to STANDBY.

5.1.19 Disconnect the test gauge.

5.1.20 Reinstall the flowmeter housing back cover.

5.1.21 Connect the pipeline hoses.

5.1.22 Perform the PMC Procedure given in Section 6.

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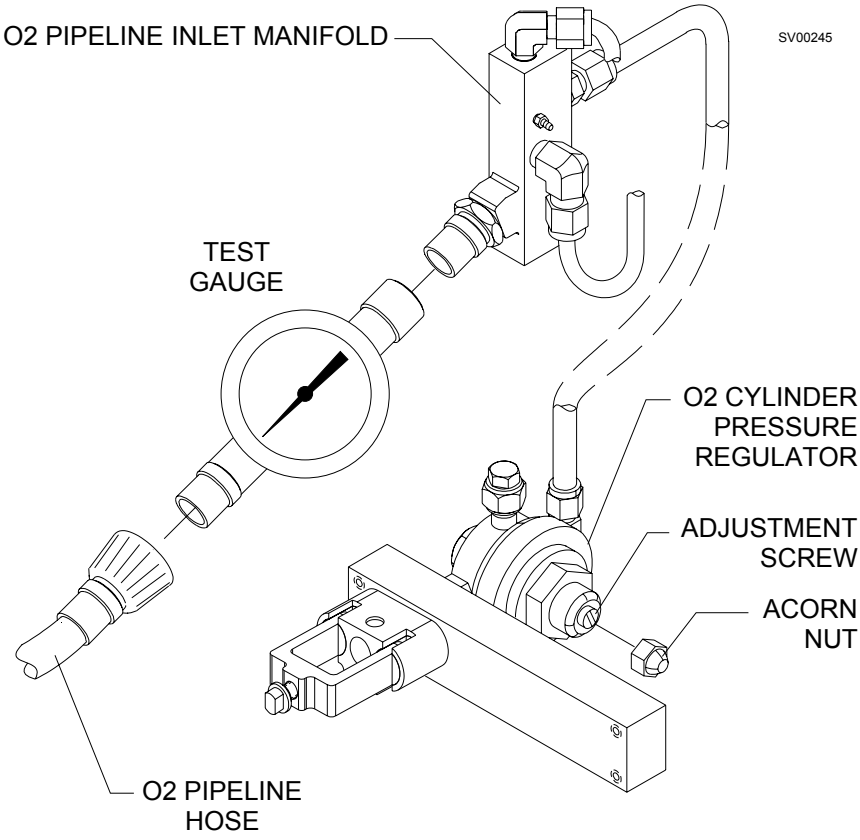


Figure 5-1. Cylinder Pressure Regulator Adjustment

5.2 Oxygen Supply Pressure Alarm Switch Adjustment

5.2.1 Disconnect all pipeline hoses and turn the System Power switch to ON.

5.2.2 Open the oxygen cylinder valve.

5.2.3 Set the oxygen flow to 5 liters per min.

5.2.4 Open the other gas flow control valves to drain pressure from the system.

5.2.5 Close the O_2 cylinder valve, and close the flow control valves. Press the O_2 Flush valve to drain oxygen pressure from the system.

5.2.6 Turn the System Power switch to STANDBY.

5.2.7 Remove the rear cover from the flowmeter housing.

5.2.8 Connect test pressure gauge (P/N 4114807) between machine's oxygen pipeline inlet connector and the oxygen pipeline supply hose.

5.2.9 Open the O_2 cylinder valve and turn the System Power switch to ON.

5.2.10 Set the oxygen flow to 200 mL per min.

5.2.11 Close the oxygen cylinder valve.

5.2.12 As the pressure drops, the O_2 SUPPLY alarm should activate when the pressure is between 40 and 34 psi as shown on the test gauge.

5.2.13 If the alarm activates when the pressure is below 34 psi or above 40 psi, turn the adjustment set screw (see illustration); repeat the test and adjust as necessary to bring the set point into the correct range.

5.2.14 Turn the System Power switch to STANDBY.

5.2.15 Disconnect the test gauge.

5.2.16 Reinstall the rear cover and its retaining screws.

5.2.17 Connect the pipeline hoses.

5.2.18 Perform the PMC Procedure given in Section 6.

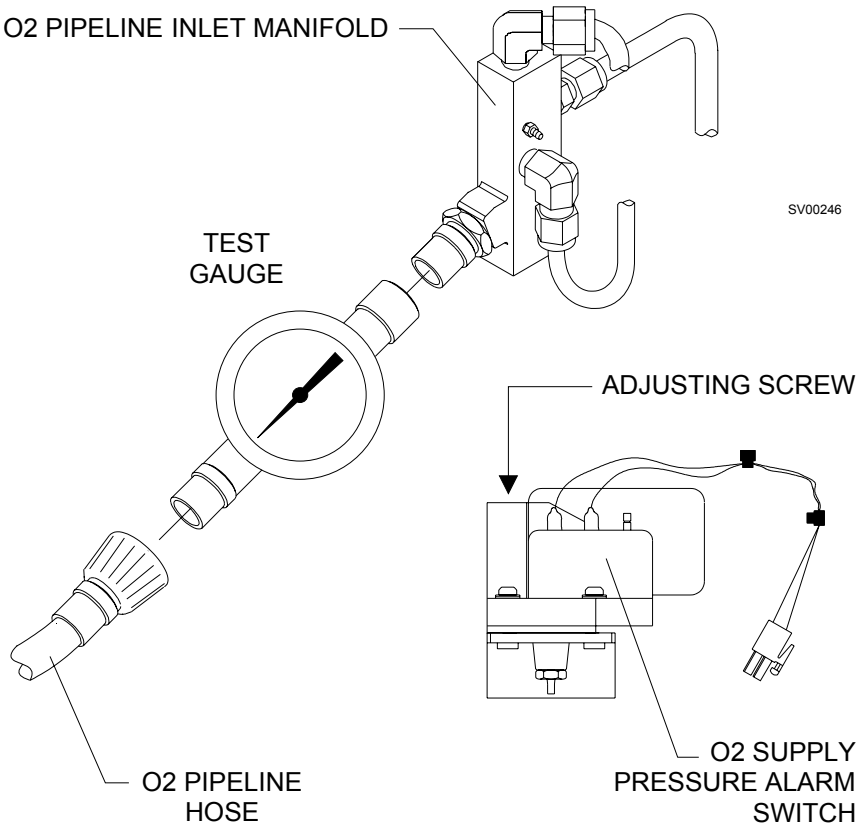


Figure 5-2. Oxygen Supply Pressure Alarm Switch Adjustment

5.3 Oxygen Ratio Controller (ORC) Adjustment

5.3.1 Remove the rear cover of the flowmeter housing.

5.3.2 Connect a calibrated oxygen monitor to the fresh gas outlet.

5.3.3 Connect the pipeline hoses.

5.3.4 Turn the System Power switch to ON.

5.3.5 Set the O_2 flow to 8 l/min.

5.3.6 Set the N_2O flow to 8 l/min.

5.3.7 Set the O_2 flow to 800 ml/min for one (1) minute. Verify that the O_2 concentration is between 21% and 29% (N_2O flow of 2.7 to 3.0 l/min.). If needed, loosen the locknut on the ORC and turn the adjusting screw (counter-clockwise to decrease N_2O flow, clockwise to increase N_2O flow) to achieve a nominal O_2 concentration of 25%.

5.3.8 Repeat the previous three steps until no further adjustment is needed. Tighten the locknut.

5.3.9 Adjust the oxygen flow to a point where the nitrous oxide flowmeter indicates 8 l/min.

5.3.10 Verify that the O_2 concentration is between 21% and 29% (O_2 flow of 2.1 to 3.3 l/min.).

5.3.11 Slowly decrease the oxygen flow to 800 l/min. The nitrous oxide flow should decrease proportionally, and the O_2 concentration should remain between 21% and 29%.

5.3.12 Close the O_2 flow control valve, and fully open the N_2O flow control valve. Verify that the O_2 concentration is between 22% and 31%.

5.3.13 Close the N_2O flow control valve and turn the System Power switch to STANDBY.

5.3.14 Replace the flowmeter housing rear cover.

5.3.15 Perform the PMC Procedure given in Section 6.

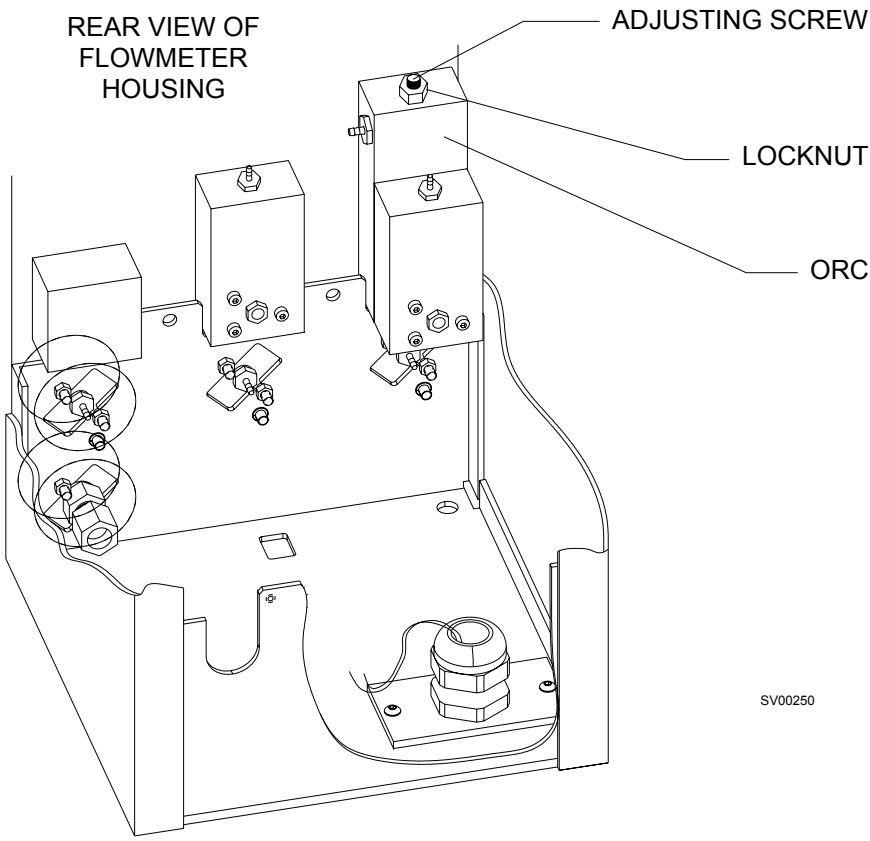


Figure 5-3. Oxygen Ratio Controller (ORC) Adjustment

5.4 Oxygen Sensor Calibration

5.4.1 Turn the System Power switch to ON.

5.4.2 Enter the Main Service Screen and select the Service Mode (ref. Section 2).

5.4.3 Enter the Oxygen Monitor Service Screen.

5.4.4 Zero Calibration

5.4.4.1 Remove the oxygen sensor capsule from its housing and allow several minutes for the displayed offset readings to stabilize.

NOTE: The difference between the displayed CELL A and CELL B readings should be no greater than 8.

5.4.4.2 Press the key next to ZERO to store the current values as the new zero calibration.

5.4.4.3 Reinstall the sensor capsule in its housing.

5.4.5 21% Calibration

5.4.5.1 Expose the sensor to ambient air only (away from any open part of the breathing system) and allow it to stabilize for several minutes.

5.4.5.2 Press the key next to EXIT to return to the Main Service Screen. Press the key next to EXIT again to return the display to normal operation.

5.4.5.3 Press the CAL key to initiate the 21% O_2 calibration.

During calibration, the LED next to the CAL key lights, and the label CAL appears in the oxygen monitor window. Following successful calibration, the currently sensed oxygen concentration appears in the oxygen monitor window.

5.4.5.4 When calibration is complete, reinstall the sensor assembly in the inspiratory valve dome.

NOTE: If the O_2 sensor will not calibrate properly, refer to the Oxygen Monitoring section of the *Narkomed M OPERATOR'S INSTRUCTION MANUAL* for further information.

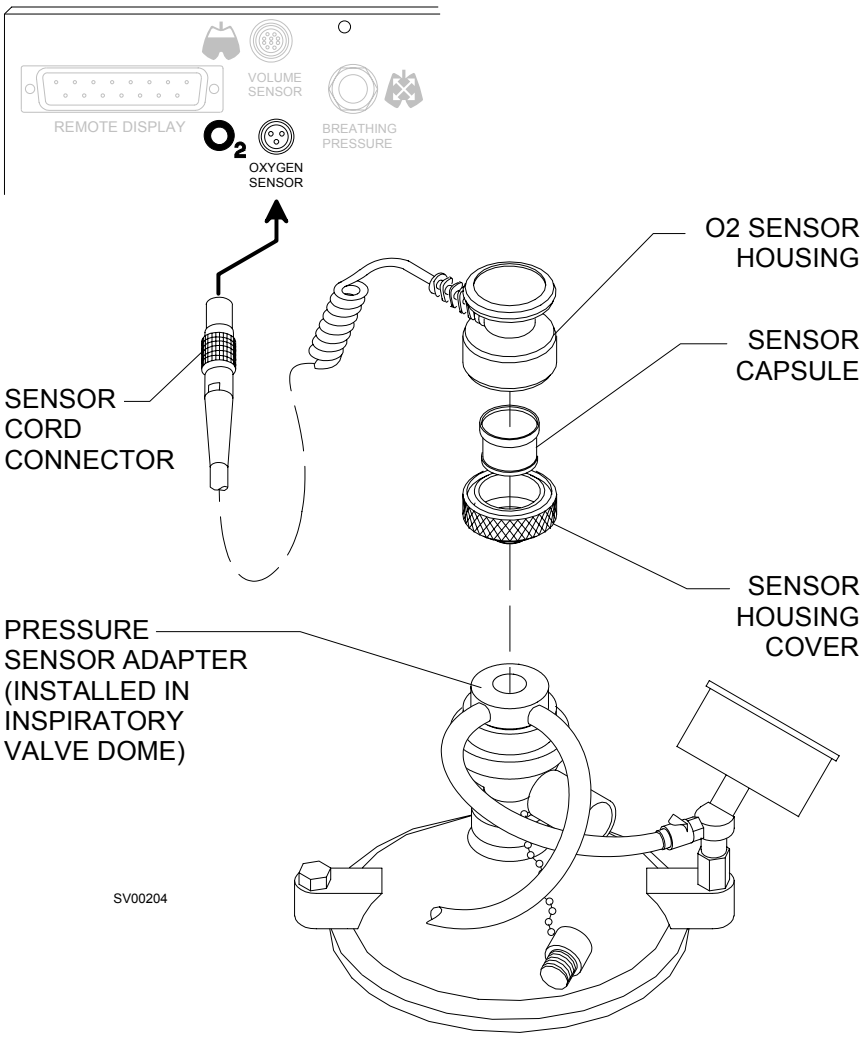


Figure 5-4. Oxygen Sensor Calibration

5.5 Breathing Pressure Monitor Calibration

5.5.1 Turn the System Power switch to ON.

5.5.2 Enter the Main Service Screen and select the Service Mode (ref. Section 2).

5.5.3 Proceed to the Pressure Monitor Service Screen.

5.5.4 Zero Calibration

5.5.4.1 Disconnect the breathing pressure hose from the interface panel on the monitor housing, and let the current pressure value stabilize.

5.5.4.2 Press the key next to ZERO to store the current value as the new zero.

5.5.5 Span Calibration

5.5.5.1 With a test fixture connected as shown in Figure 5-6, apply a pressure of 50 cm H_2O to the breathing pressure interface panel.

5.5.5.2 When the displayed current value is stabilized, press the key next to SPAN to store the current value as the new span calibration.

5.5.6 Disconnect the test fixture; reconnect the breathing pressure hose to the interface panel.

5.5.7 Press the key next to EXIT to return to the Main Service Screen.

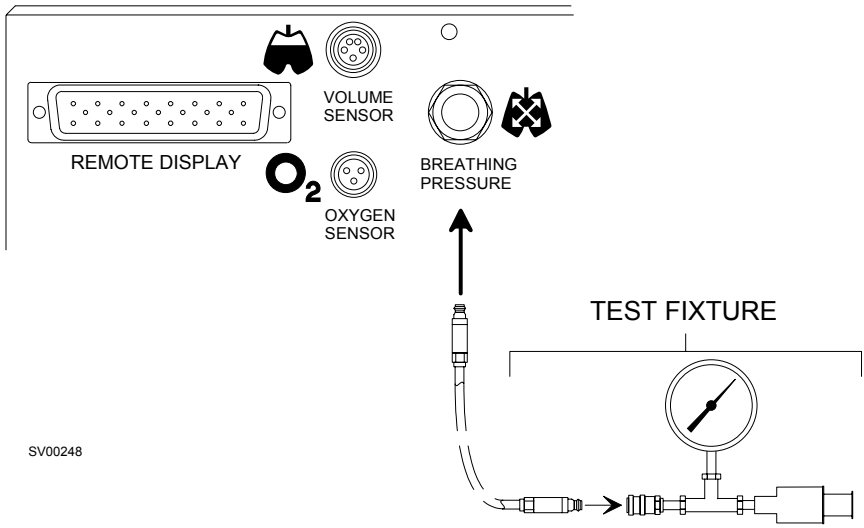


Figure 5-5. Pressure Monitor Calibration

RETURN TO THIS MANUAL'S TABLE OF CONTENTS
RETURN TO CD-ROM TABLE OF CONTENTS

6.0 PMC PROCEDURE, NARKOMED MILITARY

The procedures in this section shall be performed in their entirety each time a component is removed, replaced, calibrated, adjusted and during all scheduled Periodic Manufacturer's Certification (PMC) visits. A PMC Checklist form, P/N 4115597 is available from Draeger Medical, Inc. and shall be completed by the Technical Service Representative each time a PMC is performed. Steps in the procedure marked with (✓) require a response at the corresponding line on the checklist form.

Space is also provided on the PMC checklist form to record the results of a vapor concentration test. Refer to the current Anesthesia Equipment & Monitoring System Service Information CD-ROM Service Procedures section for vapor concentration verification procedures.

NOTE: Test equipment listed below with an asterisk (*) requires calibration at a maximum interval of one year. Verify the dates on test equipment calibration labels. DO NOT USE any test equipment having an expired calibration date. Notify your supervisor immediately if any equipment is found to be out of calibration. In the space provided at the bottom of the PMC checklist form, record the Model and ID number of all calibrated test equipment used.

In the space provided at the bottom of the PMC checklist form, record the Model and ID number of all calibrated test equipment used. Also record the calibration due dates. Examples are: multimeter, digital pressure meter, Riken gas analyzer, safety analyzer, volumeter, trace gas analyzer, simulators.

Test Equipment Required:

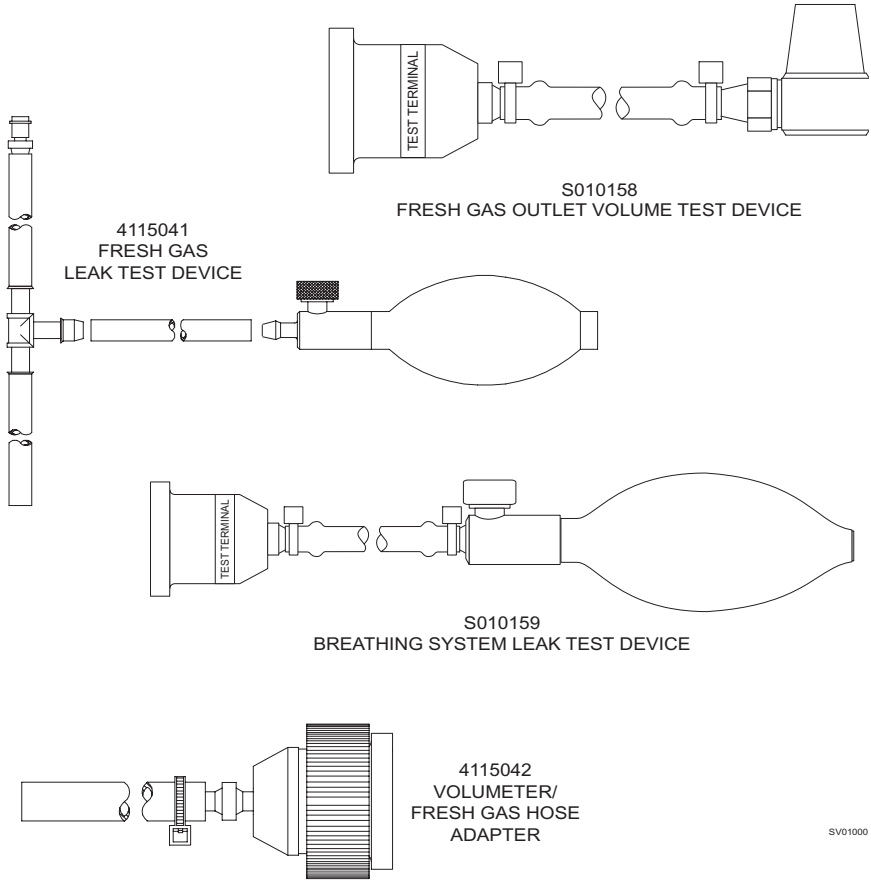
- *Electrical Safety Analyzer (Biotek 501 Pro or equivalent)
- *Pressure Gauge with DISS Adapters (P/N 4114807 or equivalent)
- *Flowmeter 0-250 ml min. (P/N S000081 or equivalent)
- *Volume Meter (P/N 2212300 or equivalent)
- *Digital Pressure Manometer (SenSym PDM 200CD or Equivalent)
- *Riken Gas Indicator (Model 18H, or 1802D or equivalent)
- Stop Watch
- Test Lung (P/N 8401892)

Materials Required:

- Spiromed Lubrication Kit (P/N 2218180)
- Breathing Bag 3 liter (P/N 9995330 or equivalent)
- Patient Circuit: Y-piece, elbow, 2x 32” x 22mm hoses
- Hose 22 mm x 32” (P/N 9995132)
- Fresh Gas Outlet Volume Test Device (P/N S010158 or equivalent)
- Fresh Gas Leak Test Adapter (P/N 4115041 or equivalent)
- Volumeter/Fresh Gas Adapter (P/N 4115042)
- Test Terminal 2x (P/N 4104389 or equivalent)
- Breathing System Leak Test Device (P/N S010159 or equivalent)
- PDM/Suction Adapter (P/N 4115038)
- Scavenger Adapter (P/N 4108114)
- Pressure Monitor Test Adapter (P/N 4115043 or equivalent)

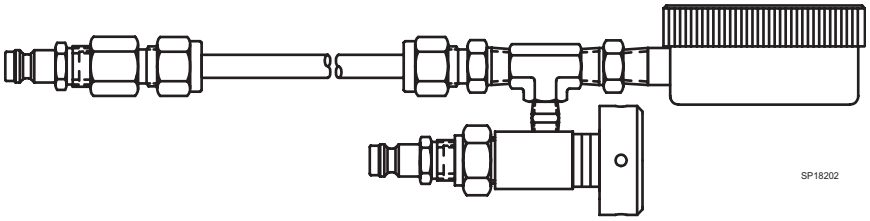
Key test equipment and materials illustrations are shown on following pages.

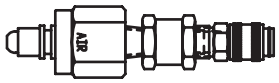
TEST EQUIPMENT AND FIXTURE ILLUSTRATIONS



TEST EQUIPMENT AND FIXTURE ILLUSTRATIONS - Continued

4114807 PRESSURE TEST ASSEMBLY , WITH ADAPTERS





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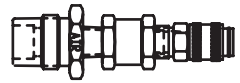

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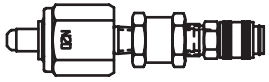

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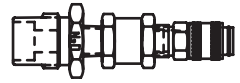
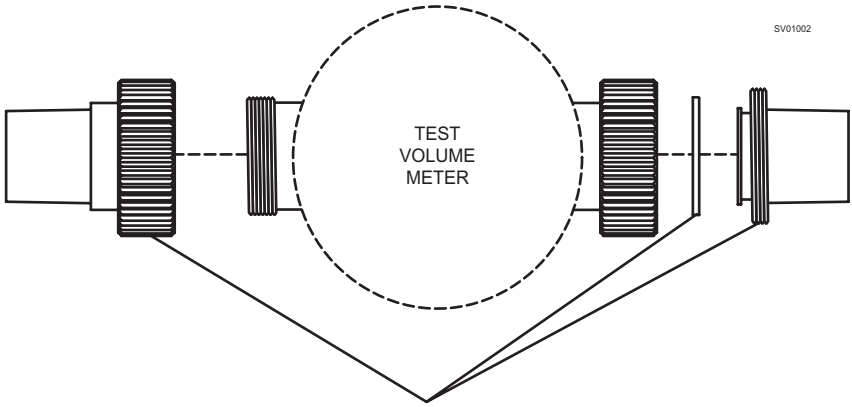


4114830-003

4114830-006

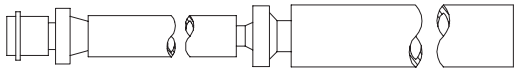
4114830-005

TEST EQUIPMENT AND FIXTURE ILLUSTRATIONS - Continued

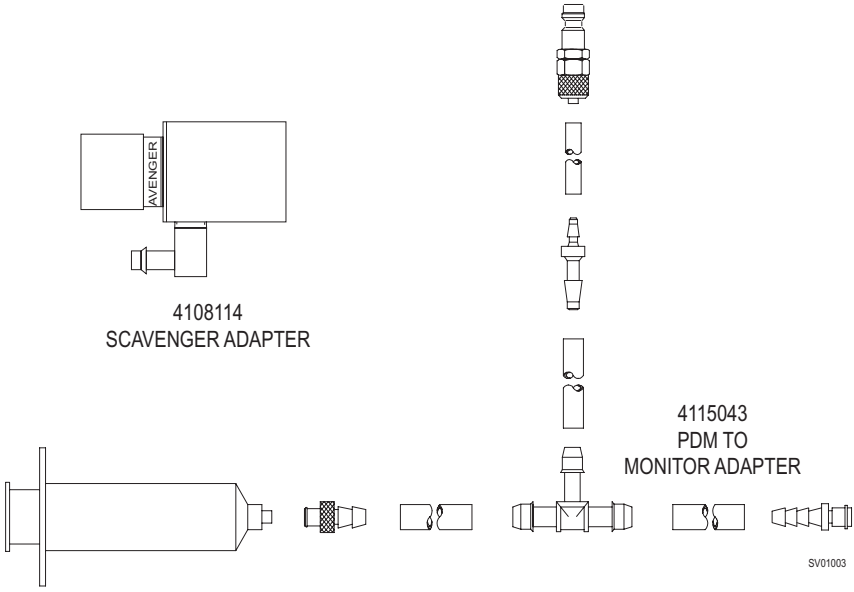


4115087 33mm x 22mm ADAPTER

TEST EQUIPMENT AND FIXTURE ILLUSTRATIONS - Continued



4115038
PDM TO PATIENT SUCTION ADAPTER

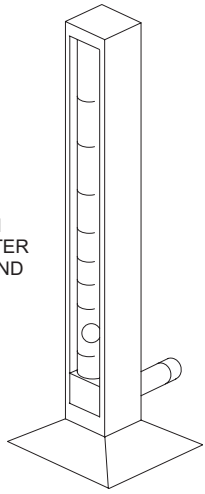


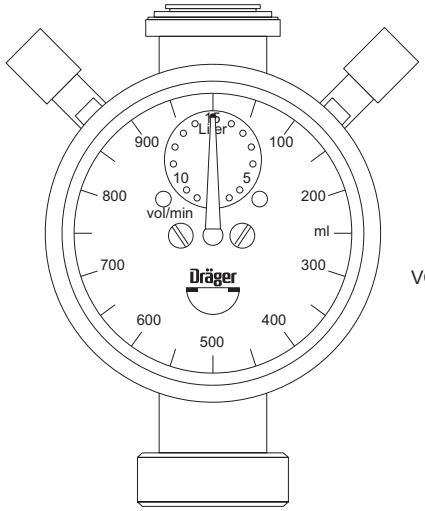
4108114
SCAVENGER ADAPTER

4115043
PDM TO
MONITOR ADAPTER

TEST EQUIPMENT AND FIXTURE ILLUSTRATIONS - Continued

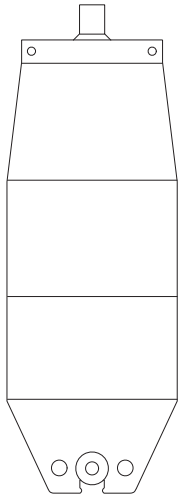
S000081
FLOW METER
TEST STAND



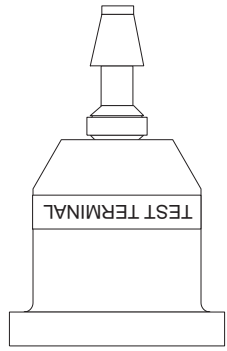


2212300
MINUTE
VOLUMETER

8401892
SIEMENS TEST LUNG



4104389
TEST TERMINAL
ADAPTER



SV01004

Periodic Manufacturer's Certification General Instructions

The purpose of these procedures is to provide detailed instructions for performing a Periodic Manufacturer's Certification (PMC) inspection on the Narkomed Military anesthesia machine.

A PMC consists of a complete Periodic Manufacturer's Service procedure and a certification level inspection based on Draeger Medical, Inc. Recommendations and equipment performance. Additional inspections are also performed to ensure proper product labeling.

Several additional documents have been created to assist the technician through the process. Following is a brief description of the purpose of each document.

Field Service Procedure:

Periodic Manufacturer's Certification Forms - Part Number SP00175.This procedure illustrates the sample checklists with typical periodic maintenance items filled in, including vapor concentration verification tests, parts replaced, general comments and certification levels. Also included are sample PMC labels marked to show several levels of certifications. An excerpt from Draeger Medical, Inc.'s *Anesthesia System Risk Analysis and Risk Reduction* is included, and also a sample of an Executive Summary to be furnished to the hospital's Risk Manager or Chief of Anesthesia.

Field Service Procedure:

DMI Recommendation Guidelines Index Anesthesia Systems - Part Number S010250.This Guideline was created to provide an assessment of each machine's certification. It contains various comprehensive overviews of possible equipment conditions and their associated certification levels.

The first list in the Recommendation Guidelines is a reference chart for machine certification based on equipment status. The second is an abbreviated summary of all DMI Recommendations and Failure Codes including the Condition Number, Equipment Condition, Recommended Corrections, Certification Code, and Tests Affected when applicable.

There is also a matrix classified as "Failure Codes" which identifies the correct manner in which to document equipment tests that fail, or were unable to be performed due to circumstances beyond the control of the service technician performing the inspection. (Ex: Air cylinder supply is unavailable to perform an Air High Pressure Leak test.) The Failure Codes section also indicates suggested resolution of the situation. Failure Code numbers begin at 34 and use the same certification levels strategy, and carry the same weight as NAD Recommendation equipment condition codes.

The final matrix is the most comprehensive index sorted by machine model and includes Equipment Condition, Certification Code, and DMI

Recommendations. It also specifies any suggested upgrade path including ordering information that should be taken such as installing a Bellows with Pressure Limit Control 4109664-S01 Kit, after market modification kit to a machine not equipped with pressure limit control.

The letters A, B, C, D and the Roman Numerals I, II are used as codes in the individual matrix for each model of anesthesia machine. The letters A, B, C, and D are used in descending order to indicate the certification level of the equipment. They are as follows:

A = Certified

B = Certified with Recommendations

C = Conditionally Certified

D = No Certification

Roman Numerals I and II do not affect the certification level but rather are provided to give further instructions to the end user as follows:

I = The system in its present configuration shall only be used with a CO2 monitor incorporating an apnea warning. The operator of the system is advised to frequently scan the CO2 readings and alarm thresholds.

II =The present configuration of equipment requires that the unit operate at all times with an oxygen analyzer that includes a low oxygen warning. The operator of the system is advised to frequently scan the oxygen readings and alarm limits.

Following is an explanation of machine certification levels:

Certified- No DMI Recommendations or Failure Codes apply to machine being inspected. (Only item number 33 - "No Recommendations" shall apply for this certification level.)

Certified with Recommendations- A numbered DMI Recommendation or Failure Code with a code of B applies to the machine being examined.

Conditionally Certified- A numbered DMI Recommendation or Failure Code with a code of BCI or BCII applies to the machine being examined.

No Certification- A numbered DMI Recommendation or Failure Code with a code of D applies to the machine being examined.

When multiple recommendations apply, "No Certification" would take precedence over "Conditionally Certified" and "Certified with Recommendations". "Conditionally Certified" would take precedence over "Certified with Recommendations".

For example:

A **Narkomed 2B** could have DMI Recommendation number 21 and Failure Code 61.1 that apply. 21 - No ventilator pressure limit control. Code is B. 61.1 - Enflurane agent is unavailable to test. Code is BC. Correct certification for this machine is BC, which means CONDITIONALLY CERTIFIED WITH RECOMMENDATIONS.

A **Narkomed 4** could have DMI Recommendation numbers 14 and 21 apply.14 - CO2/Agent monitor exhaust port is not properly connected to the waste gas scavenger. Code B.

21 - No ventilator pressure limit control. Code B.The correct certification for this machine is B, which means “CERTIFIED WITH RECOMMENDATIONS”.

A **Narkomed 2B, 2C** or **GS** could have DMI Recommendation 30 apply. 30 - Anesthesia machine is equipped with inhalation anesthesia vaporizers without an agent analyzer in the breathing system. Code B. The correct certification for this machine is B, which means “CERTIFIED WITH RECOMMENDATIONS”.

A **Narkomed 6000** could have no DMI Recommendations or Failure Codes apply. The correct certification level for this machine is Code A, “CERTIFIED”.

The correct certification for this machine is A, which means "CERTIFIED".

Code, D also means "NO CERTIFICATION", also means the machine shall not receive a Periodic Manufacturer's Certification label. The machine shall receive a "WARNING - This System Is Not Certified" label, P/N 4114857. This label shall be placed at a prominent location on the right side of the machine after all other previous PM and "Vigilance Audit® Validation" labels have been removed.

PM Certification Procedure for Narkomed Military Anesthesia System

1. Use the PM Certification form for Narkomed Military Anesthesia Systems (P/N 4115597).
2. Completely fill in the header information.
3. All Narkomed Military machines are equipped with Humphrey valves. No “MJV-2 LUBRICATION” is needed to be performed for this type of anesthesia machine.
4. Replace the VENTILATOR RELIEF VALVE DIAPHRAGM every 12 months in accordance with SP00075. Place a check mark and the replacement date at “VENT VALVE REPLACEMENT” line on the Periodic Manufacturer’s Certification form.
5. If machine is equipped with a HALOTHANE Dräger Vapor 19 or 19.1 vaporizer, determine if vaporizer must be inspected for soil condition one. Check the serial number plate located on the rear of the vaporizer for a plus (+) preceding the serial number. A HALOTHANE vaporizer serial number not preceded with a (+) must be tested for soil in accordance with SP00073. If vaporizer does not need to be inspected, indicate so with a plus (+) next to the “Vapor Inspection (H)” line on the Vigilance Audit form. If vaporizer is soil condition 0, indicate so with “SOIL 0” written next to the “Vapor Inspection (H)” line on the Vigilance Audit form. If vaporizer is soil condition one, indicate so with “SOIL 1” written next to the “Vapor Inspection (H)” line on the Vigilance Audit form. Place a “CAUTION DO NOT USE” label (part # 4114327) on the vaporizer, and issue a departmental alert. The TSR shall also seek permission from the equipment operator to remove the failed vaporizer from the machine and apply a replacement vaporizer or an adapter block onto the mount. All “SOIL 1” vaporizers must be removed from service for machine to receive certification.
6. Perform the vapor concentration test on all Dräger vapor vaporizers in accordance with SP00073 at a six month maximum interval. Perform the vaporizer concentration test on all Desflurane vaporizers in accordance with SP00091 for fixed mount vaporizers and SP00189 for user removable D-tec vaporizers at a six month maximum interval. For every vaporizer tested, fill out a "VAPOR VAPORIZER CALIBRATION CHECK" label (part # S010016). Information on this label shall include your signature, type of agent, date tested, a No Agent To Test or the test results @ 1%, 2.5%, 4% for H, E, I, or S vaporizers, or @ 4%, 10%, 12%, 16% for Desflurane vaporizers, and a PASS or FAIL indication. This label shall be attached to the upper right side of the vaporizer. If vaporizer fails the concentration verification, internal leak, or exclusion system tests, check "NO" in the "RECOMMENDED FOR USE" section on the PM Certification form. Place a "CAUTION DO NOT USE" label (part # 4114327) on the

vaporizer, and issue a departmental alert. The TSR shall also seek permission from the customer to remove the failed vaporizer from the machine and install a replacement vaporizer or an adapter block onto the mount. All nonfunctional vaporizers must be removed from service for machine to receive certification.

7. Proceed with PM Certification procedure. If any tests fail refer to the "Failure Codes" listing in DMI Recommendations Guidelines Index (P/N S010250) to determine correct certification level starting point. Failure codes shall be documented on the "RECOMMENDATIONS / GENERAL COMMENTS" section of the PM Certification form and on the Executive Summary. If a test fails that has not been identified by the "Failure Codes" list, consult with Draeger Medical, Inc. to assess the proper certification level.
8. Based on the "EQUIPMENT CONDITION" inspect the machine for any "DMI RECOMMENDATIONS" that would apply. Use the Narkomed Military section of the "RECOMMENDATION GUIDELINES INDEX" (P/N S010250). Note all applicable DMI recommendations on the Executive Summary. NOTE: If using a carbon form, indicate the Equipment Condition number and to see reverse side under the "RECOMMENDATIONS / GENERAL COMMENTS" section of the form.
9. Determine the correct certification level of the machine based on the combined lowest common denominator of "Equipment Conditions" and "Failure Codes". If the machine is at least conditionally certified fill out the "PM CERTIFICATION" label. Check the box(es) on the validation label where appropriate. Write the month and year, (three months from date of PM Certification) next to "NEXT VISIT DUE:". If certification level is "D", machine shall not receive a "PM CERTIFICATION" label. Any machine not receiving a PM Certification label shall receive a "WARNING NOT CERTIFIED" label, P/N 4114857. This label shall be placed at a prominent location on the left side of the machine after all other previous PMS and Vigilance Audit Validation labels have been removed.
10. In the "CERTIFICATION LEVEL" section of the PM Certification form, record the last visit certification level, the current certification level and the next visit due month and year, (three months from date of PM Certification) in the spaces provided.
11. If applicable, remove the previous PM CERTIFICATION VALIDATION label and attach the new label (P/N S010006 w/phone #, or S010007 w/o phone #) in a prominent location on the rear of the anesthesia machine.
12. Check the appropriate boxes on the "PM CERTIFICATION NOTICE" label, (part # S010011). If the machine is not certified, the last box of this notice label shall be marked. Attach this notice near the flowmeter shield of the anesthesia machine.

13. Have the customer sign each PM Certification form or the Executive Summary, and review any Failure Codes equipment conditions and DMI Recommendations with the customer.
14. Return top copy to Draeger Medical, Inc. Service Department, keep middle copy for service organization records, give bottom copy to customer.

(✓) **6.1 SELF-DIAGNOSTICS**

6.1.1 Turn the System Power switch to ON and verify the "ON" LED is lighted?

6.1.2 Verify all LED's on the keypad and ventilator displays are lit.

6.1.3 Verify that the following is displayed on the Display:

NARKOMED
COPYRIGHT 1997-1998 NAD. INC.
VERSION X.XX NARKOMED
SOFTWARE ID: XXXX

FIRMWARE	PASS
RAM	PASS
VIDEO	PASS
A/D CONVERTER	PASS
AUDIO - PRIMARY	PASS
BACKUP	PASS
SERIAL I/O	PASS
CLOCK	PASS
NON-VOLATILE MEMORY	PASS
FUNCTIONAL	

(✓) 6.1.4 Record the machine software version on the header of the checklist form.

6.2 ELECTRICAL SAFETY- One Year Service Interval; Due Date _____

(✓) 6.2.1 Battery Check & Ground Continuity

6.2.1.1 Unplug the AC power cord for all devices mounted to the machine that may provide an alternate path to earth ground, such as a Desflurane vaporizer.

6.2.1.2 Unplug the machine's AC power cord and plug the power cord of the safety analyzer into this AC receptacle.

NOTE: Do not plug the safety analyzer power cord into a line isolation monitor circuit, as inaccurate readings may occur.

NOTE: The BIOTECH 501 PRO will automatically test the source outlet for open ground (or ground resistance of 31 Ohms or higher), reverse polarity, open neutral and open line. (The latter two conditions will prevent the analyzer from powering up.)

6.2.1.3 Is the green "AC POWER" LED off? __ (Y)

6.2.1.4 Does the "AC PWR FAIL" message appear in the Advisory display? __ (Y)

6.2.1.5 Press and hold the "BATTERY TEST" button.

6.2.1.6 Is green Battery Test LED lighted? __ (Y)

6.2.1.7 Release the "BATTERY TEST" button.

6.2.1.8 Turn on the safety analyzer and configure it to measure “Resistance” according to the manufacturers documentation. Attach a test lead to the “SINGLE LEAD” connector of the analyzer. Connect the other end of the test lead to the AC receptacle ground socket on the safety analyzer. Verify a displayed resistance of 0.00 ohms or, if necessary, calibrate the unit according to manufacturers documentation.

6.2.1.9 Plug the machine’s AC power cord into the safety analyzer.

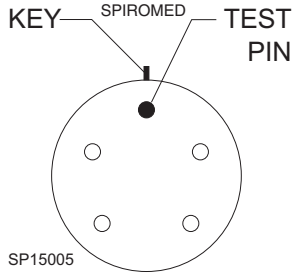
6.2.1.10 Apply the analyzer’s test lead to a cylinder yoke bolt.

6.2.1.11 What is the value displayed on the safety analyzer? ___ ohm (0-0.1)

(✓) 6.2.2 Circuit Isolation

6.2.2.1 Disconnect the respiratory volume sensor cord from the interface panel.

6.2.2.2 Using a multimeter set to its highest resistance range apply the test leads between the yoke bolt and circuit common at the volume interface test pin. Use the twelve o'clock position indicated on the illustration for the Spiromed connector. There shall be no continuity between these two points.



6.2.2.3 Reconnect the respiratory volume sensor cord to the interface panel.

6.2.3 Chassis Leakage Current

6.2.3.1 Apply the analyzer test lead to a cylinder yoke bolt.

6.2.3.2 Configure the safety analyzer to the measure "CHASSIS LEAKAGE CURRENT" according to the manufacturers documentation.

6.2.3.3 Record the total leakage current with the Polarity and Ground switches set as follows:

		Ground	Polarity
(✓)	6.2.3.3.1	Normal	Normal
(✓)	6.2.3.3.2	Open	Normal
(✓)	6.2.3.3.3	Open	Reversed
(✓)	6.2.3.3.4	Normal	Reversed

6.2.3.4 Verify that the leakage current is 100* microamps or less in each of the switch positions (110 microamps or less for the 220/240 volt power supply option).

6.2.3.5 300 microamps if external monitors are plugged into convenience receptacles.

6.2.3.6 Shut off and unplug the safety analyzer. Remove the anesthesia machine plug from the analyzer and plug it back into the original AC receptacle.

(✓) **6.3 CONFIGURATION**

6.3.1 Press the CONFIG key.

6.3.2 The CONFIGURE screen is displayed.

6.3.3 Verify the correct Time and Date.

6.3.4 Press the exit key to exit the function.

6.4 SERVICE DATA

6.4.1 Press and hold the Oxygen High Limit key and the Volume Low Limit key, and then press the UP ARROW key.

6.4.2 The Main Service Screen shall appear.

6.4.3 Select and enter the Service Log.

6.4.4 Verify any pertinent information from the Service Log. Contact the Draeger Medical, Inc. Technical Service Department if necessary.

6.4.5 Press EXIT to return to the Main Service screen.

6.4.6 Using the arrow keys, select the SRVC Service Code.

6.4.7 Press the SELECT key and enter your Technical Service Rep. I.D. number.

(✓) 6.4.8 Press the RESET key. This resets the last service date to the current date and resets the hours run since last service to zero.

6.4.9 Press the PMS SCHED key.

(✓) 6.4.10 Select and enter the month of the next service due date.

NOTE: The internal clock of the machine limits the amount of date advance to a maximum of six months from the current service date.

6.4.11 Press the EXIT key to return the main service screen. If not performing monitor calibrations, press the EXIT key again to return to normal operation mode.

6.5 CALIBRATIONS - One Year Service Interval; Due Date _____

6.5.1 To bring up the Oxygen Monitor Service Screen, press the Mon Cal key.

6.5.2 Remove the Oxygen sensor from the Breathing Pressure Hose Assembly, and remove the Oxygen Sensor capsule from the Oxygen Sensor Housing.

(✓) 6.5.3 When the CURRENT CELL A and CURRENT CELL B readings have stabilized, press the ZERO key and verify that the new offset values are stored.

NOTE: The higher the offset, the higher the calculated O2 concentration appears at high concentrations.

6.5.4 Put the Oxygen Sensor capsule into the Oxygen Sensor Housing.

6.5.5 Press the PRES MON key.

6.5.6 Remove Breathing Pressure Hose Assembly from Inspiratory Valve dome to expose the Breathing Pressure Sensor line to ambient pressure.

6.5.7 Let the Current Pressure Value stabilize and press the ZERO key to store the value.

6.5.8 Remove Breathing Pressure Sensor line from the Breathing Pressure interface.

6.5.9 Connect a Pressure Monitor Adapter, (P/N 4115043) and calibrated manometer to the Breathing Pressure interface.

NOTE: Zero manometer prior to connecting to monitor interface. Slight pressure will be noticed on manometer when connected to monitor interface, DO NOT re-zero manometer.

6.5.10 Pressurize the circuit to 50 cm H2O and allow the [Current Value] to stabilize.

(✓) 6.5.11 Press the SPAN key and verify that the new span values are stored.

6.5.12 Release the pressure, disconnect the manometer and test fixture, reconnect the Breathing Pressure Sensor line to the Breathing Pressure interface and insert the Breathing Pressure Hose Assembly into Inspiratory Valve dome.

6.5.13 Press EXIT to return to the Main Service screen.

6.5.14 Press EXIT to return to normal operation.

(✓) 6.6 ABSORBER INSPECTION

Absorber System Inspection and Maintenance

6.6.1 Remove the O2 Sensor Housing and/or Oxygen Sensor Plug and Breathing Pressure Hose Assembly from the inspiratory valve dome and examine the O-rings on each assembly. Replace O-rings as necessary.

6.6.2 Remove the Inspiratory and the Expiratory valve domes.

6.6.3 Are any pins on the valve crater damaged? Inspiratory ___ (N) Expiratory ___ (N) Replace complete valves as necessary.

6.6.4 Are any pins on the valve domes damaged? Inspiratory ___ (N) Expiratory ___ (N) Replace complete valves as necessary.

6.6.5 Is the valve disc in good condition? Inspiratory ___ (Y) Expiratory ___ (Y) Replace as necessary.

6.6.6 Are the valve dome washers in good condition? ___ (Y) Replace washers as necessary.

6.6.7 Reinstall the Inspiratory and Expiratory valve domes.

6.6.8 THIS STEP INTENTIONALLY LEFT BLANK

(✓) **6.6.9 SPIROMED SENSOR**

6.6.9.1 Remove the expiratory valve.

6.6.9.2 Is the washer under the valve in good condition? ___ (Y) Replace washer as necessary.

6.6.9.3 Remove the Spiromed Sensor.

6.6.9.4 Is the washer under the sensor in good condition? ___ (Y) Replace washer as necessary.

6.6.9.5 Remove the PEEP valve.

6.6.9.6 Is the washer under the PEEP valve in good condition? ____(Y) Replace washer as necessary.

6.6.9.7 Reattach the PEEP valve.

6.6.9.8 Locate the four lateral holes at the sides of the Spiromed Sensor marked by arrows.

Caution: Use only the Sensor Lubrication Kit (P/N 2218180) for the following procedure.

6.6.9.9 Dip the tip of the pipette into the lubricant and draw lubricant into the pipette by pulling the pin backwards.

6.6.9.10 Insert the pipette into one of the four holes as far as it will go. Push the pin forward to its stop to inject lubricant into the hole.

6.6.9.11 Repeat the previous 2 steps for lubrication of the three remaining holes.

6.6.9.12 Wipe any lubricant residue from the exterior of the sensor.

6.6.9.13 Reattach the Spiromed Sensor to the PEEP valve.

6.6.9.14 Reattach the Expiratory valve to Spiromed Sensor.

6.6.9.15 Remove the Inspiratory valve assembly.

6.6.9.16 Is the washer under the valve in good condition? ___ (Y) Replace washer as necessary.

6.6.9.17 Reinstall the Inspiratory valve.

6.6.9.18 Is there a wing nut on each absorber rod? ___ (Y)

6.6.9.19 Inspect the following: canister, canister gaskets, dust cup and O-ring, and soda lime.

6.6.9.20 Are the canister, canister gaskets, dust cup and O-ring, and soda lime in good condition? ___ (Y) Replace components as necessary.

6.6.9.21 Verify the cm H2O gauge is at zero (0) and readjust/replace as necessary.

NOTE: The small slotted screw is the zero adjustment.

6.6.9.22 Reinstall the Breathing Pressure Hose Assembly into the Inspiratory valve dome.

6.6.9.23 Reinstall the O2 Sensor plug into the Breathing Pressure Hose Assembly.

6.6.9.24 Remove the Freshgas Hose Assembly from the FRESHGAS OUTLET.

6.6.9.25 Is the Freshgas Hose Assembly and Freshgas Outlet in good condition? ___ (Y)

6.6.9.26 Reconnect the Freshgas Hose Assembly to the FRESHGAS OUTLET.

(✓) 6.7 HIGH PRESSURE LEAK

NOTE: Minimum cylinder pressures required for High Pressure Leak tests are:

N2O: 600 psi;

O2, Air: 1000 psi.

6.7.1 Turn the machine to Standby.

6.7.2 Verify the Auxiliary Oxygen flow control valve is closed

6.7.3 Disconnect all pipeline supply hoses at the wall outlets.

6.7.4 Open then close and remove each cylinder. And if applicable remove the yoke plug from each additional yoke assembly.

6.7.5 Note the reading on each of the cylinder pressure gauges and start a stop watch.

6.7.6 Are there two (2) yoke index pins installed securely in each yoke? ___(Y)

6.7.7 Is the proper gas I.D. label affixed to each yoke? ___ (Y)

6.7.8 After two (2) minutes, is the pressure loss equal to or less than 50 PSI? ___(Y)

6.7.9 Verify the presence of only one (1) cylinder washer, then reattach and secure the cylinders to each yoke assembly, then open each cylinder valve.

6.8 BREATHING SYSTEM

6.8.1 Absorber & Freshgas Leak/ Vaporizer Leak

6.8.1.1 Close all flow control valves.

6.8.1.2 Set the AUTO/BAG selector to BAG.

6.8.1.3 Close the APL valve.

6.8.1.4 Interconnect the Inspiratory valve and expiratory valve on the with a 22 mm hose (P/N 9995132).

6.8.1.5 Attach a Freshgas Leak Test Adapter (P/N 4115041), Test Terminal Adapter (P/N 4104389), and Digital Pressure Manometer to the bag mount.

6.8.1.6 Apply 50 cm H2O test pressure to the absorber system and start a stop watch.

6.8.1.7 Is the pressure on the manometer within 49 to 51 cm H2O? ___ (Y)

6.8.1.8 Is the pressure displayed on the Breathing Pressure Gauge +/- 3 cm H2O of the value displayed on the test manometer?___(Y)

(✓) 6.8.1.9 After thirty (30) seconds, is the pressure displayed on the manometer equal to or greater than 40 cm H2O? ___(Y)

6.8.1.10 If applicable, turn on the vaporizer to the first graduated marking. Reapply 50 cm H2O of pressure to the system and start a stopwatch.

(✓) 6.8.1.11 After thirty (30) seconds, is the vaporizer test pressure displayed on the manometer equal to or greater than 40 cm H2O? ___(Y). Turn off the vaporizer.

(✓) ### 6.8.2 APL Valve

6.8.2.1 Open the APL valve to its stop.

6.8.2.2 Verify Scavenger is active.

6.8.2.3 Turn the System Power switch to ON.

6.8.2.4 Set the Oxygen flow to 8 l/min.

6.8.2.5 Is the test pressure within 0 to 3 cm H2O? ___ (Y)

6.8.2.6 Remove Freshgas Leak Test Adapter (P/N 4115041), Test Terminal Adapter (P/N 4104389), and Digital Pressure Manometer from the bag mount.

(✓) 6.8.3 O2 Flush

6.8.3.1 Attach a 33 mm x 22 Female Adapter (P/N 4115087) to the top port of the test volumeter.

6.8.3.2 Remove the ventilator hose from the absorber and bellows, and connect to the Bag Mount terminal.

6.8.3.3 Connect test volumeter to the end of ventilator hose.

6.8.3.4 Close the APL valve.

6.8.3.5 Press and hold the O2 FLUSH button for 6 seconds; multiply the value obtained by 10.

6.8.3.6 Is the calculated Oxygen flush flow rate within 45 to 65 l/min.? ___ (Y)

6.8.3.7 After releasing the flush, does the flow of Oxygen stop immediately? ___ (Y)

6.8.3.8 Reattach ventilator hose between absorber and bellows ventilator terminals.

6.8.3.9 Remove all test equipment. Remove 22mm hose from Inspiratory valve and expiratory valve.

(✓) 6.8.4 Expiratory Valve Leak

6.8.4.1 Connect a 22 mm hose (P/N 9995132) between the Inspiratory valve and the bag mount.

6.8.4.2 Connect a test terminal (P/N 4104389) to the expiratory valve.

6.8.4.3 Connect a 0-250 ml/min. flowmeter (P/N S000081) to the test terminal.

6.8.4.4 Turn up the Oxygen flow until the system pressurizes to 30 cm H2O. Adjust the APL valve as necessary to maintain 30 cm H2O.

6.8.4.5 Is the value indicated on the flowmeter within 0 to 60 ml/min.? ___ (Y)

6.8.4.6 Turn off O2 flow. Fully close APL valve.

6.8.4.7 Remove all test equipment.

(✓) 6.8.5 Inspiratory Valve Leak

6.8.5.1 Turn the System Power switch to Standby.

6.8.5.2 Connect a test terminal (P/N 4104389) to the Inspiratory valve.

6.8.5.3 Connect a Fresh Gas Leak Adapter (P/N 4115041) and manometer to the test terminal on the Inspiratory valve.

6.8.5.4 Connect another test terminal to the bag mount.

6.8.5.5 Connect a 0-250 ml/min. flowmeter (S000081) to the test terminal on the bag mount.

6.8.5.6 Pressurize the test circuit to 30 cm H2O.

6.8.5.7 Is the value indicated on the flowmeter within 0 to 60 ml/min.? ___ (Y)

6.8.5.8 Turn the system power switch to ON.

6.8.5.9 Remove all test equipment.

(✓) 6.8.6 Absorber PEEP Valve

6.8.6.1 Open the APL valve.

6.8.6.2 Disconnect the Breathing Pressure Sensor line going to the Breathing Pressure interface and connect to a test manometer.

6.8.6.3 Connect a Fresh Gas Outlet Volume Test Device (S010158) to the Fresh gas outlet.

6.8.6.4 Install a test breathing circuit or disposable breathing circuit onto the Inspiratory and Expiratory valves of the absorber.

6.8.6.5 Connect the test terminal, of the Fresh Gas Outlet Volume Test Device, to the Y-piece of the breathing circuit.

6.8.6.6 Set the O2 flow to 5 l/min.

6.8.6.7 Adjust the absorber PEEP valve clockwise to the maximum position.

6.8.6.8 Does the PEEP valve adjust smoothly? ___ (Y)

6.8.6.9 Is the maximum PEEP indicated on the test gauge greater than 15 cm H2O? ___ (Y)

6.8.6.10 Adjust the absorber PEEP valve counterclockwise to its minimum position.

6.8.6.11 Is the PEEP indicated on the test gauge less than or equal to 3 cm H2O? ___(Y)

6.8.6.12 Close the O2 flow control valve.

6.8.6.13 Remove the test equipment and reconnect the Breathing Pressure Sensor line to the Breathing Pressure interface.

6.9 OXYGEN ANALYZER

6.9.1 Press the Cal key.

NOTE: Ensure that the sensor has stabilized in ambient air for several minutes.

(✓) 6.9.2 After calibration is completed, is the O2 concentration 21%? ___ (Y)

6.9.3 The warning message INSP O2 LOW shall appear on the central alarm display, and an audible alarm shall sound.

6.9.4 Press the ALARM SILENCE key and verify the audio alarm is silenced.

6.9.5 Remove the Breathing Pressure Hose Assembly from the Inspiratory valve dome.

6.9.6 Place the Oxygen Sensor housing directly into the Inspiratory valve dome.

6.9.7 Verify the AUTO/BAG selector is set to BAG.

6.9.8 Close the APL valve.

6.9.9 Attach a 22 mm hose (P/N 9995132) to the Inspiratory valve.

6.9.10 Attach a Breathing System Leak Test Device (P/N S010159) to the bag mount.

6.9.11 Press the O2 Flush.

6.9.12 After 20 seconds, is the O2 concentration within 90 to 100 %? ___ (Y)

6.9.13 Release the O2 Flush, does the flow cease immediately? ___ (Y)

6.9.14 Set the Oxygen flow to 8 l/min.

(✓) 6.9.15 After 1 minute, is the O2 concentration within 97 to 100 %? ___ (Y)

6.10 FLOWMETERS & CONCENTRATIONS

(✓) 6.10.1 Oxygen Flowmeter

6.10.1.1 Is it possible to adjust the flow of Oxygen over the full range of the flowmeters? ___ (Y)

6.10.1.2 Set the Oxygen flow to 4 l/min.

6.10.1.3 Is the correct flow control knob and label attached to the Oxygen flow control valve? ___ (Y)

(✓) 6.10.2 Air Flowmeter

6.10.2.1 If not configured with an Air Cylinder yoke, attach the Air Pipeline hose.

6.10.2.2 Is it possible to adjust the flow of the Air over the full range of the flowmeter? ___ (Y)

6.10.2.3 Set the Air flow to 2 l/min.

6.10.2.4 After the value stabilizes, is the O2 concentration within 71 to 77 %? ___ (Y)

6.10.2.5 Close the Air flow control valve.

6.10.2.6 Is the correct flow control knob and label attached to the Air flow control valve? ___ (Y)

6.10.3 Nitrous Oxide Flowmeter

6.10.3.1 Set the Nitrous Oxide flow to 2 l/min.

6.10.3.2 After the value stabilizes, is the O2 concentration within 64 to 70 %? ___ (Y)

6.10.3.3 Is the correct flow control knob and label attached to the Nitrous Oxide flow control valve? ___ (Y)

6.10.3.4 Is it possible to adjust the flow of nitrous oxide over the full range of the flowmeter? ___ (Y)

(✓) 6.10.4 Oxygen Ratio Control

6.10.4.1 Open the Nitrous Oxide flow control valve to the stop position.

6.10.4.2 After the value stabilizes, is the O2 concentration within 21 to 29 %? ___ (Y)

6.10.4.3 Set the Oxygen flow to 2 l/min.

6.10.4.4 After the value stabilizes, is the O2 concentration within 21 to 29 %? ___ (Y)

6.10.4.5 Set the Oxygen flow to 1 l/min.

6.10.4.6 After the value stabilizes, is the O2 concentration within 21 to 29 %? ___ (Y)

6.10.4.7 Close the Oxygen flow control valve.

6.10.4.8 Close the Nitrous Oxide flow control valve.

(✓) 6.10.5 Auxiliary Oxygen Flowmeter

6.10.5.1 Connect a test manometer to the Auxiliary Oxygen outlet using a PDM/Suction Adapter (P/N 4115038).

6.10.5.2 Slowly open flowmeter valve until a pressure of 50 cm H2O is achieved.

6.10.5.3 Close flowmeter valve.

6.10.5.4 After 10 seconds, is the pressure within 40 to 60 cm H2O? ___ (Y)

6.10.5.5 Remove the test manometer and adapter.

6.10.5.6 Is it possible to adjust the Auxiliary Oxygen flowmeter over the full range of the flowmeter? ___(Y)

6.10.5.7 Set the Auxiliary O2 flow rate to 5 L/min.

6.10.5.8 Hold the Oxygen sensor at the Auxiliary Oxygen flowmeter outlet.

6.10.5.9 After the value stabilizes, is the O2 concentration within 80 to 100 %? ___ (Y)

6.10.5.10 Reinstall the Breathing Pressure Hose Assembly.

6.10.5.11 Insert the Oxygen sensor into the Breathing Pressure Hose Assembly.

6.10.5.12 Close the Auxiliary Oxygen flow control valve.

6.11 HIGH PRESSURE REGULATORS – Six Month Service Interval; Due Date _____

(✓) 6.11.1 N2O Regulator- if applicable

NOTE: Minimum cylinder pressure for N2O regulator test is 600 psi.

6.11.1.1 Configure the test gauge (P/N 4114807) using a N2O nut/stem DISS connector (P/N 4114830-004) on the hose, and N2O DISS body connector (P/N 4114830-003) on the valve body side. If the machine is configured with CSA style fittings reverse the position of the connectors.

6.11.1.2 Connect the test fixture hose to the machine's Nitrous Oxide pipeline inlet.

6.11.1.3 Connect the Nitrous Oxide pipeline supply hose to the test fixture.

6.11.1.4 Open the Nitrous Oxide and the Oxygen cylinder valves.

6.11.1.5 Set the Oxygen and Nitrous Oxide flows to 4 l/min.

6.11.1.6 Depress the push button on the test device.

6.11.1.7 Release the push button. After the pressure decay stabilizes, is the regulator output pressure within 40 to 49 psi? ___ (Y)

6.11.1.8 Remove the test fixture.

NOTE: If a pressure decrease does not occur, either the hospital's supply pressure is too low or the regulator pressure is set too high.

(✓) 6.11.2 O2 Regulator

NOTE: Minimum cylinder pressure for O2 regulator test is 1000 psi.

6.11.2.1 Configure a test gauge (P/N 4114807) using an O2 nut/stem DISS connector (P/N 4114830-006) on the hose and an O2 DISS body connector (P/N 4114830-005) on the valve body side. If the machine is configured with CSA style fittings reverse the position of the connectors.

6.11.2.2 Connect the test fixture hose to the machine's Oxygen pipeline inlet.

6.11.2.3 Connect the Oxygen pipeline supply hose to the test fixture.

6.11.2.4 Set the Oxygen flow to 4 l/min.

6.11.2.5 Depress the push button on the test device.

6.11.2.6 Release the push button. After the pressure decay stabilizes, is the regulator output pressure within tolerance given in the following table? ___ (Y)

NOTE: If a pressure decrease does not occur, either the hospital's supply pressure is too low or the regulator pressure is set too high.

Cylinder Pressure psi	USA Compensated Regulator output tolerances	CSA Compensated Regulator output tolerances
2000	38 to 44	41 to 47
1800	39 to 45	42 to 48
1600	40 to 46	43 to 49
1400	41 to 47	44 to 50
1200	42 to 48	45 to 51
1000	43 to 49	46 to 52

(✓) **6.12 LOW O2 SUPPLY – Six Month Service Interval; Due Date _____**

6.12.1 Close the Oxygen Cylinder valve and drain Oxygen cylinder pressure.

6.12.2 Depress the push button on the test device.

6.12.3 Adjust the Oxygen flow to 500 ml/min.

6.12.4 Release the test device push button.

6.12.5 Is the pressure on the test gauge when the LO O2 SUPPLY message appears on the monitor within 34 to 40 psi? ___ (Y)

6.12.6 Close O2 Flow control valve.

6.12.7 Remove the test equipment.

6.13 OXYGEN SUPPLY FAILURE PROTECTION

6.13.1 Connect all pipeline supplies.

(✓) 6.13.2 *Is the flow of Oxygen 150 to 200 ml/min.? ___ (Y)

6.13.3 Open the Nitrous Oxide flow control valve.

(✓) 6.13.4 *Is the flow of Nitrous Oxide within 375-750 ml/min.? ___ (Y)

6.13.5 Adjust the Oxygen, Nitrous Oxide and AIR gases to 4 l/min.

6.13.6 Disconnect the Oxygen pipeline supply and close the Oxygen cylinder valve.

(✓) 6.13.7 Do all fresh gas flows cease when the Oxygen pressure is depleted? ___(Y)

6.13.8 Reconnect the Oxygen pipeline supply.

6.13.9 Close all cylinder valves and then disconnect the Nitrous Oxide pipeline supply.

6.13.10 Drain the cylinder contents then reconnect the pipeline supplies.

6.13.11 Close all flow control valves.

* Nitrous Oxide Bypass flow and Minimum Oxygen flow specifications are given @ 50 psi. Pipeline pressure deviations may affect these tests.

6.14 PRESSURE MONITOR

6.14.1 Disconnect the Breathing Pressure Sensor line from the Breathing Pressure interface on the machine.

6.14.2 Connect a PDM to Monitor Adapter (P/N 4115043) and test manometer to the Breathing Pressure interface on the machine.

6.14.3 Adjust the test pressure to 0 cm H2O.

6.14.4 Simultaneously turn “ON” the ventilator and start a stopwatch.

(✓) 6.14.5 Does the APNEA PRESSURE alarm appear on the alarm display as a CAUTION within 13 to 17 seconds? ___ (Y)

(✓) 6.14.6 Increase the test pressure slowly. Does the APNEA PRESSURE alarm deactivate within 10 to 14 cm H2O? ___ (Y)

6.14.7 First decrease the pressure then increase the test pressure above the threshold line shown on the display, and begin timing with a stopwatch.

(✓) 6.14.8 Does the CONTINUOUS PRES alarm appear as a warning within 13 to 17 seconds? ___ (Y)

(✓) 6.14.9 Decrease the pressure slowly. Does the CONTINUOUS PRES alarm deactivate within 10 to 14 cm H2O? ___ (Y)

(✓) 6.14.10 Increase the test pressure slowly. Does a VENT PRESS HI alarm activate as a warning alarm within 47 to 53 cm H2O? ___ (Y)

(✓) 6.14.11 Increase the sub-atmospheric test pressure slowly. Does the SUB ATM PRES warning alarm activate within –7 to –13 cm H2O? ___ (Y)

6.14.12 Turn the ventilator “OFF”.

6.14.13 Open APL valve.

6.14.14 Remove the test equipment and reconnect the Breathing Pressure Sensor line to the Breathing Pressure interface.

6.15 VENTILATOR

NOTE: Readjustment of inspiratory flow to limit the inspiratory plateau may be required to reduce erratic tidal volumes and breath rates caused by artifact volumes.

6.15.1 Remove the bellows vent hose and the scavenger hose at the ventilator relief valve. Remove the bellows sub-assembly and remove bellows.

6.15.2 Visually inspect the bellows for deterioration particularly at it's seems and corrugations. Replace as necessary.

6.15.3 Verify the presence and condition of it's sealing O-ring. Replace as necessary. Reassemble all components.

6.15.4 Set O2/AIR mode switch to "O2".

6.15.5 Turn the ventilator "ON".

6.15.6 Set the FREQUENCY to 10 BPM.

(✓) 6.15.7 Press and hold the EXTENDED RANGE switch and set the I:E ratio to 2:1. Using a stopwatch, time the extended I:E ratio. Is the inspiratory time within 3.6 to 4.4 seconds and the expiratory time within 1.8 to 2.2 seconds? ___ (Y)

(✓) 6.15.8 Set the I:E RATIO to 1:2. Using a stopwatch, time the I:E ratio. Is the inspiratory time within 1.8 to 2.2 seconds and the expiratory time within 3.6 to 4.4 seconds? ___ (Y)

6.15.9 Adjust the Oxygen flow to 500 ml/min.

6.15.10 Set the Tidal Volume to 1200.

6.15.11 Attach a patient circuit to the absorber system.

6.15.12 Set the pressure limit control to MAX.

6.15.13 Adjust the Inspiratory Flow to the bottom of the LOW zone.

6.15.14 Occlude the Y-piece.

6.15.15 Press the O2 Flush momentarily to inflate the bellows.

6.15.16 Adjust the Inspiratory Flow until a peak pressure of 80 cm H2O is achieved.

(✓) 6.15.17 Set the Pressure Limit Control to within the 30 range. Readjust within the band as necessary to achieve proper value, is the peak pressure at the 30 range within 27 to 33 cm H2O? ___ (Y)

(✓) 6.15.18 Set the Pressure Limit Control to the MIN position. Is the peak pressure at the MIN range within 0 to 15 cm H2O? ___ (Y) Return the Pressure Limit control to MAX.

6.15.19 Loosen the expiratory valve.

(✓) 6.15.20 Does the Reverse Flow message appear on the display? ___ (Y)

6.15.21 Reconnect the hose between the expiratory valve and the flow sensor.

6.15.22 Insert a test minute volumeter between the Spiromed and the absorber dome.

6.15.23 Open the Y-piece.

6.15.24 Turn the ventilator off and press the ALL STBY key to clear alarms.

6.15.25 Turn the ventilator “ON” and start a stop watch.

6.15.26 Does APNEA-VOLUME appear as a Caution within 13 to 17 seconds? ___ (Y)

6.15.27 Attach a 3 liter breathing bag to the Y-piece.

NOTE: Bag should be placed on a flat horizontal surface to reduce artifact volume.

6.15.28 Press the O2 Flush momentarily to inflate the bellows.

6.15.29 Set the Inspiratory Flow to the MED and readjust as necessary to fully collapse the bellows.

(✓) 6.15.30 Observe the operation of each unidirectional valve disc at eye level and make sure the inspiratory valve disc raises only during the inspiration phase, and the expiratory valve raises only during the exhalation phase.

(✓) 6.15.31 Is the tidal volume on the volume monitor and on the test volumeter within 20 % of each other? ___ (Y)

6.15.32 Does the volume monitor display 10 BPM? ___ (Y)

6.15.33 Does the display correctly track the Breathing Pressure waveform? ___ (Y)

6.15.34 Verify AIR pipeline hose is connected.

(✓) 6.15.35 Set O2/AIR mode switch to “AIR”. Does ventilator continue to cycle properly. ___(Y)

6.15.36 Set O2/AIR mode switch back to “O2”.

6.16 BELLOWS ADULT

(✓) 6.16.1 What is the tidal volume indicated on the test volumeter within 960 to 1440 ml? ___ (Y)

(✓) 6.16.2 Does the bellows remain fully inflated during the expiratory pause phase? ___ (Y)

6.16.3 Remove the ventilator hose from the bellows hose terminal.

6.16.4 Attach a test terminal to the bellows hose terminal.

6.16.5 Connect a 0-250 ml/min. flowmeter (P/N S000081) to the test terminal.

6.16.6 Set the FREQUENCY to 1 BPM.

(✓) 6.16.7 Is the drive gas leakage indicated during the inspiratory phase within 0 to 50 ml/min.? ___ (Y)

6.16.8 Remove the test equipment from the ventilator hose terminal and reconnect the ventilator hose to the bellows ventilator hose terminal.

6.16.9 Set the FREQUENCY to 10 BPM.

6.16.10 Adjust the O2 flow to 8 l/min.

6.16.11 Adjust the Tidal Volume to maximum.

6.16.12 Press the O2 Flush momentarily to inflate the bellows.

6.16.13 Adjust the INSPIRATORY FLOW to fully compress the bellows.

(✓) 6.16.14 Is the Tidal Volume on the test volumeter greater than or equal to 1400 ml? ___(Y)

(✓) 6.16.15 Is the PEEP value displayed on the monitor within 0 to 3 cm H2O? ___ (Y)

6.16.16 Remove the breathing bag from the Y-piece and replace it with a test lung.

6.16.17 Adjust the O2 flow to 300 ml/min.

6.16.18 Adjust the Tidal Volume to 200 ml.

6.16.19 Does the bellows stop adjust smoothly and engage properly? ___ (Y)

6.16.20 Adjust the INSPIRATORY FLOW to fully compress the bellows.

(✓) 6.16.21 Is the Tidal Volume on the test volumeter within 125 to 250 ml? ___ (Y)

6.16.22 Close the Oxygen flow control valve.

6.16.23 Remove the test lung and set the AUTO/BAG selector to BAG.

6.16.24 Press the Alarms All Standby key.

6.17 SCAVENGER- Six Month Service Interval; Due Date _____

NOTE: If the ambient air in the local environment contains a significant amount of dust and lint, the cleaning frequency must be increased to compensate for these conditions.

(✓) 6.17.1 Scavenger - Passive Mode

6.17.1.1 Remove the scavenger hoses and drain all accumulated moisture. Inspect all scavenger hoses for deterioration and replace as necessary. Reinstall hoses and bag.

6.17.1.2 Ensure that the suction needle valve (not used in passive mode) is closed.

6.17.1.3 Positive Pressure Test:

6.17.1.3.1 Connect a 19mm scavenger hose between the Vent Relief valve and the top port of the scavenger. Connect another 19 mm scavenger hose between APL valve and the second scavenger port.

6.17.1.3.2 Interconnect the inspiratory valve and expiratory valve or expiratory port on the ultrasonic flow sensor, if applicable with a 22 mm hose (P/N 9995132).

6.17.1.3.3 Set Man/Auto valve to “Auto”.

6.17.1.3.4 Verify PEEP valve is at minimum (counter-clockwise).

6.17.1.3.5 Set O2 Flow to 8 l/min.

6.17.1.3.6 Occlude the bottom 19 mm connector (EXHAUST).

6.17.1.3.7 After the bellows inflates, the flow of oxygen will exit the system through the positive pressure safety relief valve.

6.17.1.3.8 Is the pressure displayed on absorber cm H2O gauge is less than or equal to 5 cm H2O?___(Y)

(✓) 6.17.2 Scavenger - Suction Mode

6.17.2.1 Remove the scavenger hoses and drain all accumulated moisture. Inspect all scavenger hoses and scavenger bag for deterioration and replace as necessary. Reinstall hoses and bag.

6.17.2.2 Remove the filter from the negative pressure relief valve. Clean and reinstall the filter.

6.17.2.3 Negative Pressure Test:

6.17.2.3.1 Interconnect the inspiratory valve and expiratory valve or expiratory port on the ultrasonic flow sensor, if applicable with a 22 mm hose (P/N 9995132).

6.17.2.3.2 Set Man/Auto valve to “BAG” position

6.17.2.3.3 Fully open APL valve.

6.17.2.3.4 Attach a Breathing System Leak Test Device (P/N S010159) to the bag mount (occlude bag mount).

6.17.2.3.5 Verify Suction system is active. Adjust needle valve to allow typical suction through scavenger.

6.17.2.3.6 Verify all flow control valves are closed.

6.17.2.3.7 Install scavenger adapter (P/N 4108114) between either of the 19 mm scavenger connectors and scavenger hose. Connect a manometer to the hose barb on the scavenger adapter and observe reading on manometer. The manometer shall indicate a pressure less than or equal to 0.5 cm H2O.

6.17.2.4 Positive Pressure Test:

6.17.2.4.1 Fully close scavenger needle valve.

6.17.2.4.2 Push the O2 flush to inflate scavenger bag. Open oxygen flow control valve to 8 l/min.

6.17.2.4.3 Verify reading on manometer is less than or equal to 5 cm H2O.

6.17.2.4.4 Remove all test equipment. Adjust scavenger needle valve to allow typical suction through scavenger.

6.18 FINAL TESTS

(✓) 6.18.1 Is the machine's Operator's Instruction manual in close proximity of the machine? ___ (Y)

6.18.2 Verify all cylinder pressure gauges indicate zero.

6.18.3 Verify the pipeline hoses are connected to the hospital pipeline.

6.18.4 Verify the APL valve knob is turned completely counterclockwise (fully open).

6.18.5 Place the AUTO/BAG selector in the BAG position.

6.18.6 Verify the ventilator hose is connected between the AUTO/BAG valve and bellows ventilator hose terminal.

6.18.7 Verify the Breathing Pressure Sensor line is connected to the Breathing Pressure interface on the machine.

6.18.8 Verify the Oxygen sensor is removed from the inspiratory valve dome.

6.18.9 Verify that the Inspiratory valve dome is plugged.

6.18.10 Verify that the machine is plugged into a live A/C receptacle.

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7.0 Software Update Procedure

This section outlines the software installation procedure, including the equipment needed and its connections.

Software updates to the Narkomed M anesthesia system are done through a serial port connection to an external PC using the batch file LOADM.BAT.

7.1 Software Transfer to PC Via Modem

Equipment required:

- Interface Cable, NAD Part No. 4109882 P (9-pin to 25-pin)

  or 4110328 A (9-pin to 9-pin)

- IBM® PC or IBM PC Compatible configured with:
  - PC-DOS or MS-DOS V3.3 or higher
  - RS-232C Serial Port connected to COM 1
  - Hard Drive or Floppy Drive
  - Modem (or external modem)

7.1.1 Download the software to the hard disk or use Drive A (floppy drive) on the PC.

7.2 Installing Narkomed M Software from a PC

7.2.1 Set the System Power switch on the NARKOMED M to STANDBY, and the power switch on the PC to OFF.

7.2.2 Connect the appropriate interface cable (9-pin or 25-pin) to COM 1 on the PC, and connect the other end of the cable to the Narkomed M serial interface port as shown in Figure 7-1.

7.2.3 Power up the PC and wait for the DOS prompt to appear on the screen.

7.2.4 Set the PC to read the drive holding the software. For example: if the software was downloaded to drive A, type A: and press ENTER.

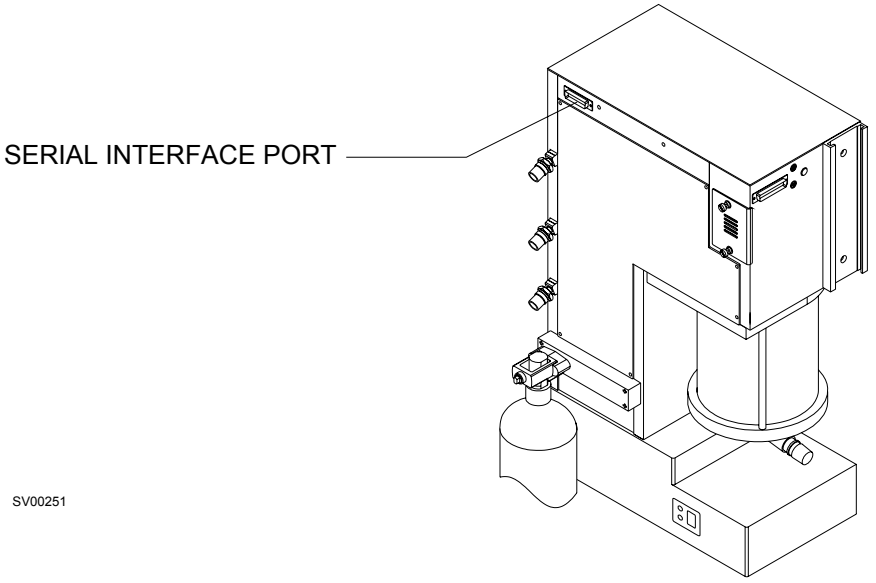


Figure 7-1. Narkomed M Serial Port Location

7.2.5 Type LOADNMM and press ENTER.

7.2.6 Turn the System Power switch to ON.

7.2.7 As the software is downloading, the Narkomed M screen will be blank for approximately 5 to 7 minutes, and the incremental number of bytes sent will be displayed on the PC screen. When the download is complete, the PC screen will display

```
\       Bytes sent:    0    Images sent:    1
```

Software installation is complete when the machine resets.

7.2.8 Set the System Power switch on the Narkomed M to STANDBY, and the power switch on the PC to OFF. Disconnect the interface cable.

8.0 Spare and Replacement Parts

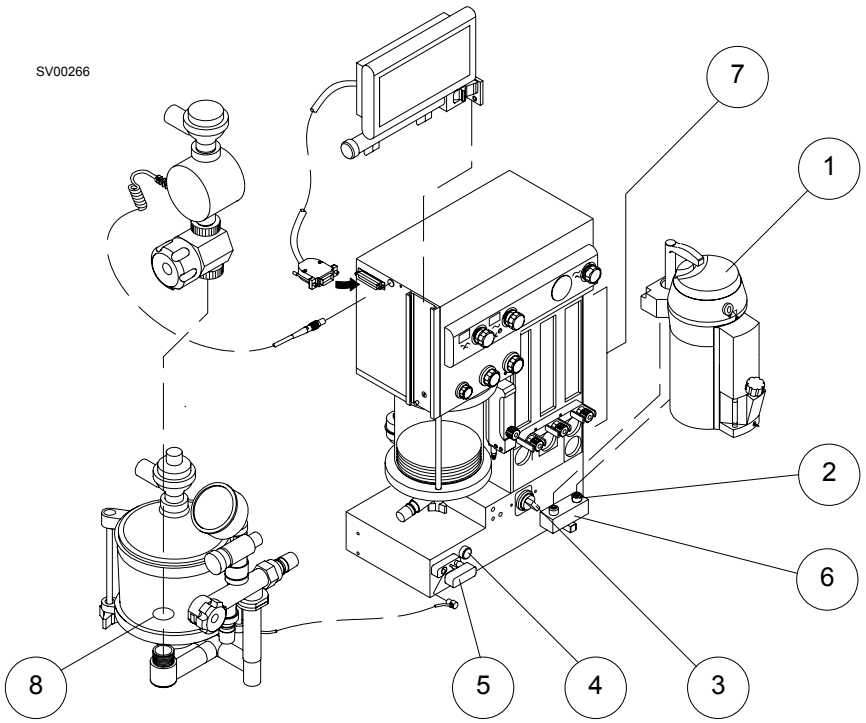
Part numbers for field-replaceable items on the Narkomed M anesthesia system are listed on the following pages, along with part numbers for related hardware and cables.

The item numbers are keyed to the accompanying illustrations to aid in identifying the item and its location.

ASSEMBLY/PART **PAGE**

Vaporizer & rel. parts, fresh gas outlet, mainswitch, flowmtr sub-asm 8-2, 8-3
Covers, battery, pwr supp, hoses, VPO asm, pwr cord 8-4, 8-5
Case #2, items not part of machine 8-6, 8-7
Case #1, accessories 8-8, 8-9
Hoses, bags, Y-pieces, elbows 8-10, 8-11
Processor Assembly and related parts. 8-12, 8-13
Ventilator Controller (Bezel Assembly) 8-14, 8-15
Bellows Valve Assembly 8-16, 8-17
Bellows Valve Assembly Details 8-18, 8-19
Display Assembly and Monitor Support Arm 8-20, 8-21
Pipeline Inlet (Manifold) Assemblies. 8-22, 8-23
Failsafe (OFPD) and ORC Assemblies 8-24, 8-25
Main Switch Assembly 8-26, 8-27
O_2 Supply Pressure Switch, O_2 - Air Switch. 8-28, 8-29
Flowmeter Shield, Gauges 8-30, 8-31
Flow Tubes, Restrictor Assemblies, Flow Control Valves. 8-32, 8-33
Auxiliary O_2 Flowmeter 8-34, 8-35
Cyl. Yoke and Regulator Assembly, O_2 Flush Valve 8-36, 8-37
Frame Assembly, Casters, Basket 8-38, 8-39
Power Supply Assembly and related items 8-40, 8-41
Absorber, Inspiratory Valve, Gauge. 8-42, 8-43
Valve, Man/Auto Selector 8-44, 8-45
Breathing Pressure Hose Assembly, O_2 Sensor, Spiromed Sensor, PEEP Valve, Expiratory valve 8-46, 8-47
Scavenger 8-48, 8-49
Miscellaneous Items 8-50

SPARE AND REPLACEMENT PARTS (continued)



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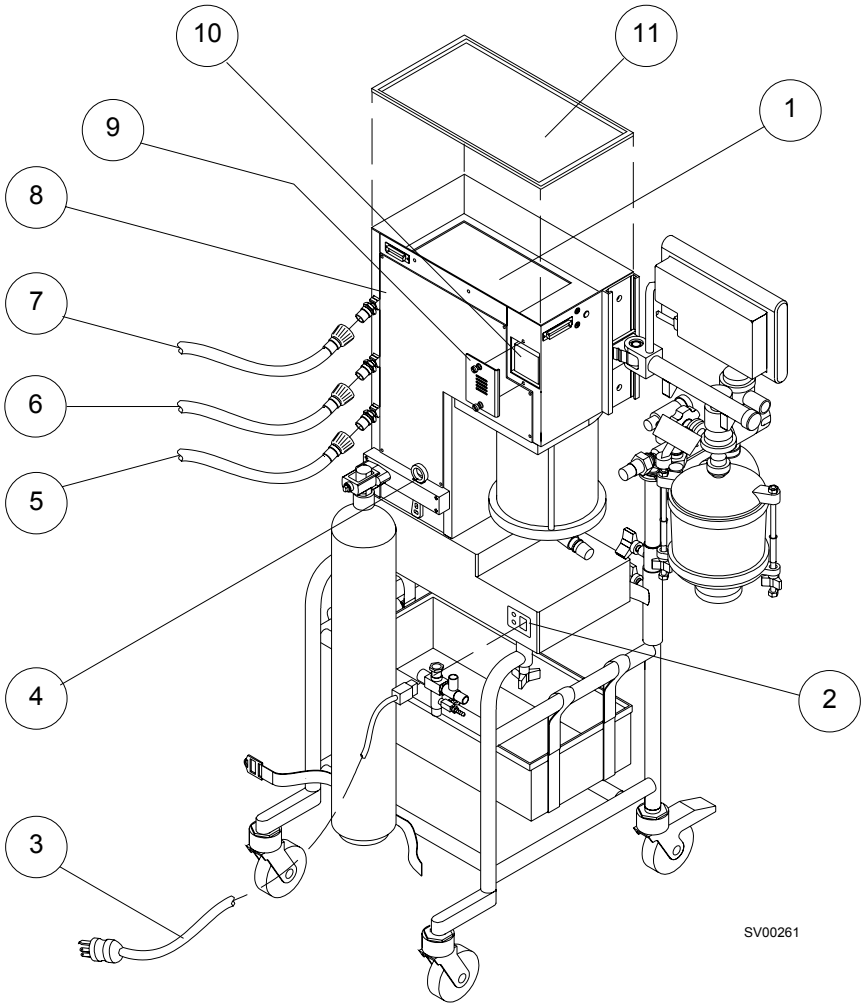
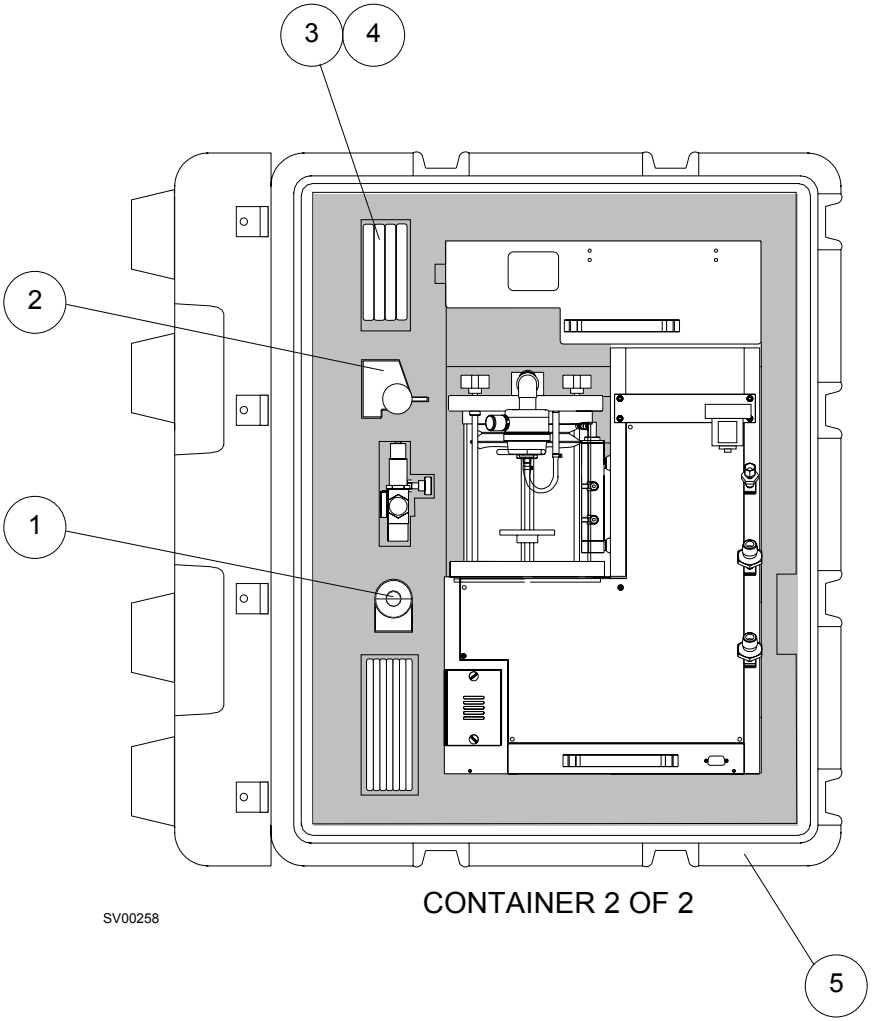
ITEM	DESCRIPTION	PART NUMBER
1	Vaporizer	4114279
2	O-ring, vaporizer post (2x)	S4114346
3	Mainswitch Assembly	4114278
4	O2 Flush valve	4103340
5	Fresh Gas outlet assembly	4108673
6	Vapor block assembly	4115019-004
7	Flowmeter sub-assembly	4114276
8	Gasket, absorber dome-spiromed	1101690-001

SPARE AND REPLACEMENT PARTS (continued)



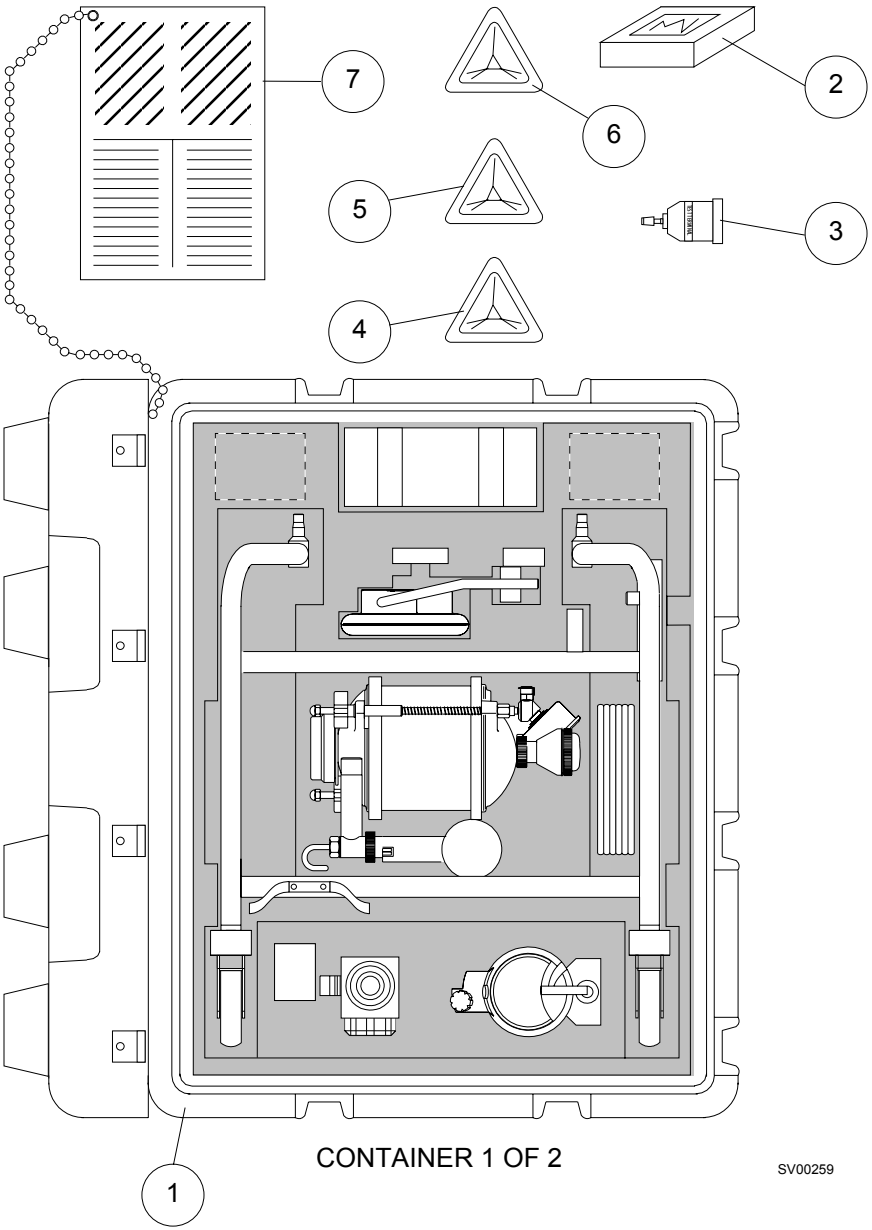
ITEM	DESCRIPTION	PART NUMBER
1	Ventilation Monitor (VPO Assembly)	4113780-001
2	Power Supply	4114284
3	Power Cord, 6 ft	4110334
4	Cylinder Wrench	4103737
5	Hose Assembly, N2O	4113712-010
6	Hose Assembly, Air	4113713-010
7	Hose Assembly, O2	4113714-010
8	Cover, Flowmeter rear	4116282
9	Cover, Battery compartment	4114298
10	Battery, 12V rechargeable	4114229
11	Shelf Assembly (top cover)	4114174



CONTAINER 2 OF 2

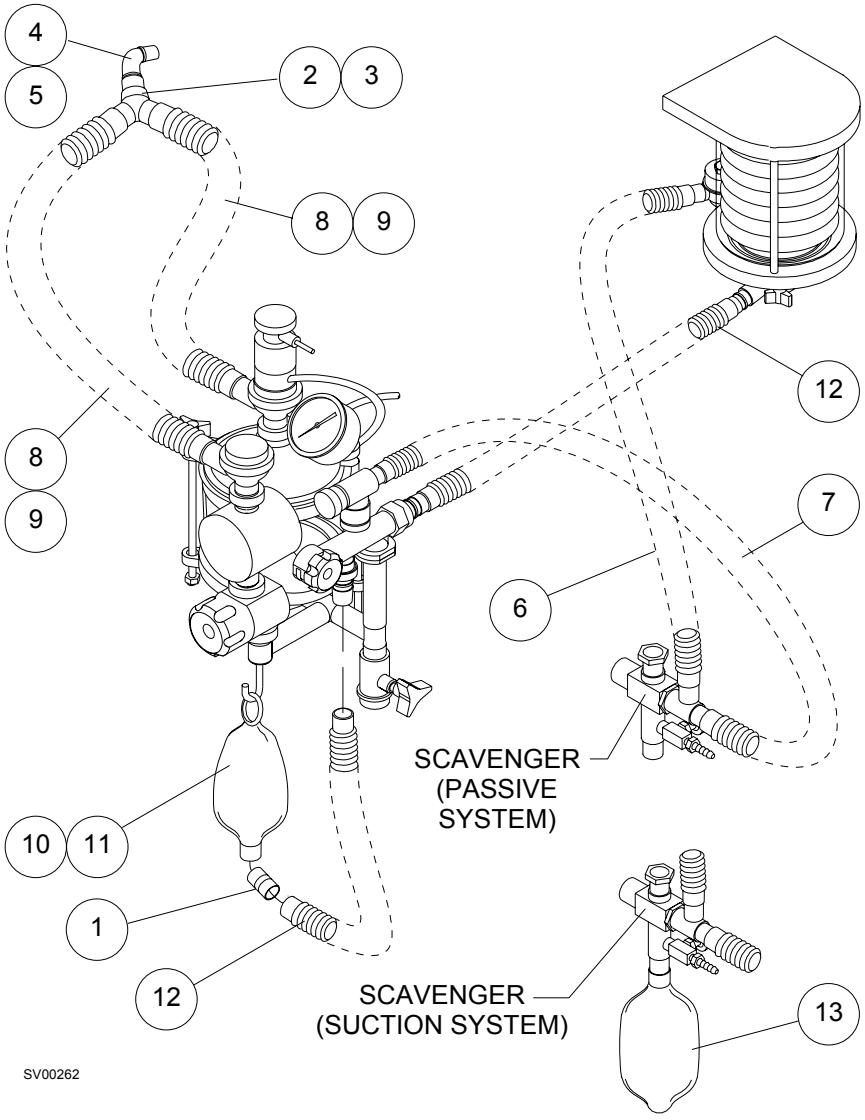
ITEM	DESCRIPTION	PART NUMBER
1	Regulator, O2 (external)	4113705-001
2	Regulator, N2O (external)	4113705-002
3	Operator's Instruction Manual (2x)	4114107
4	Technical Service Manual (2x)	4114108
5	Case #2	4114319-002

SPARE AND REPLACEMENT PARTS (continued)



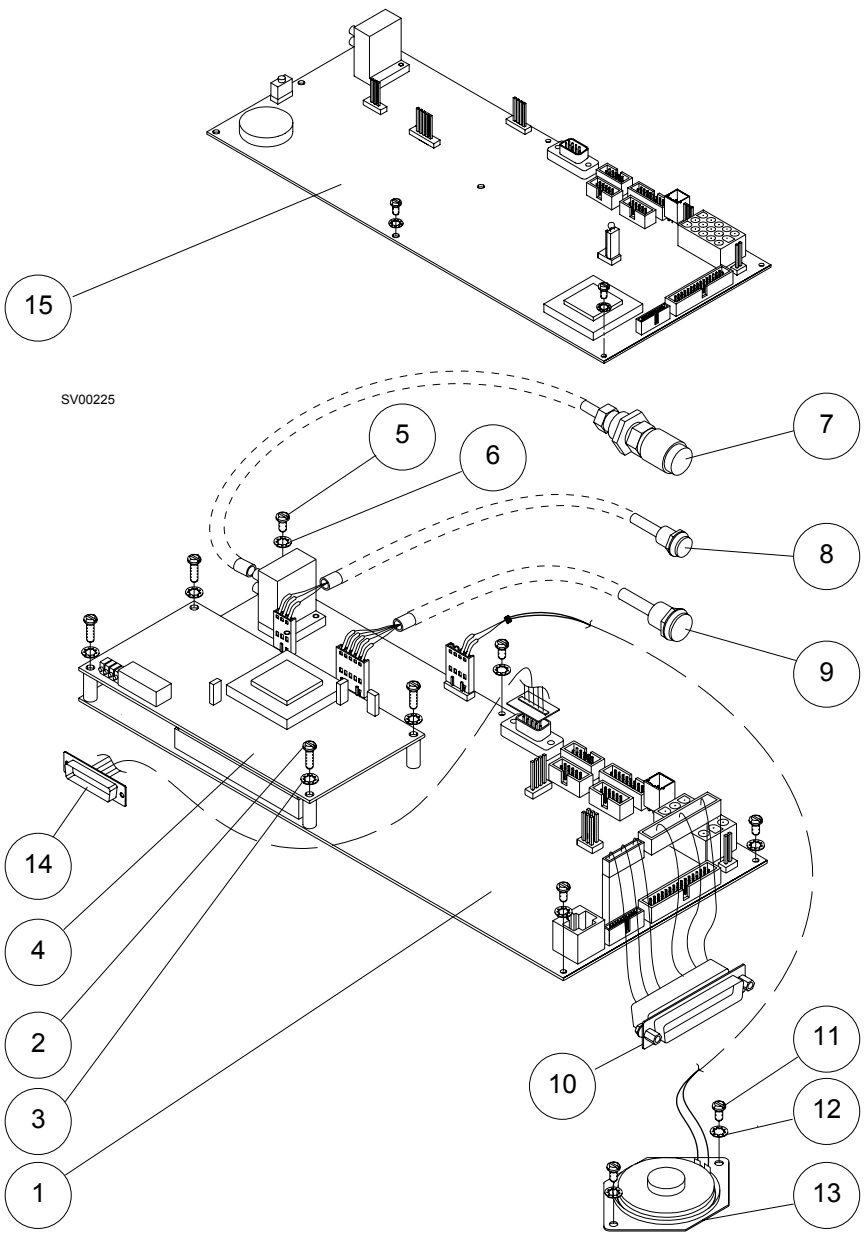
ITEM	DESCRIPTION	PART NUMBER
1	Case #1	4114319-001
2	Spiromed Lubrication kit	2218180
3	Test Terminal Adapter	4104389
4	Facemask, anatomical infant, SZ1	9995001
5	Facemask, anatomical child, SZ2	9995002
6	Facemask, anatomical large, SZ5	9995005
7	Assembly / Disassembly Instructions (setup card)	4114362

SPARE AND REPLACEMENT PARTS (continued)

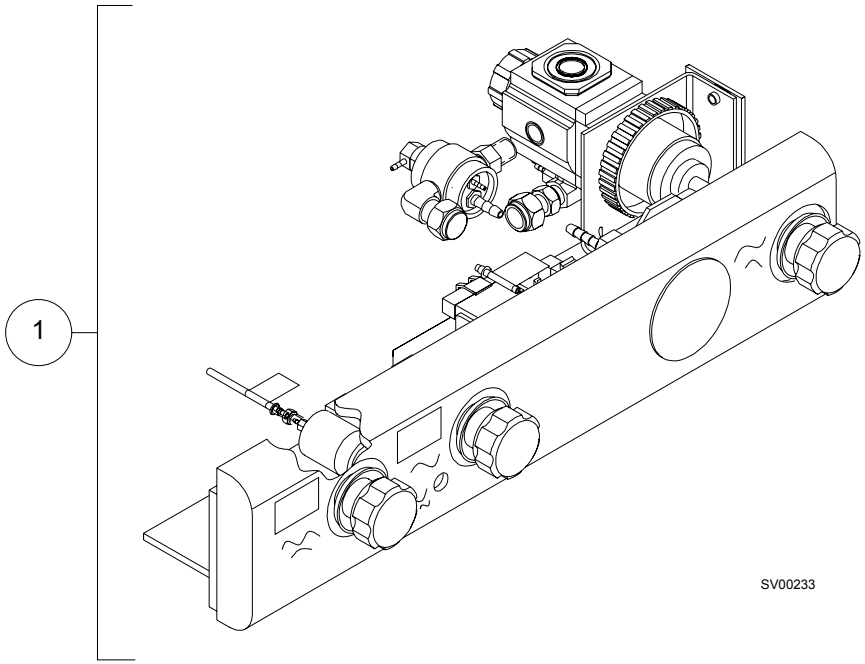


ITEM	DESCRIPTION	PART NUMBER
1	Connector, breathing bag - hose	4114312
2	Y-piece, adult	M25650
3	Y-piece, pediatric	4114357
4	Elbow, adult mask	4107319
5	Elbow, pediatric mask	4114358
6	Hose, corrugated, 19 mm bushings, 13 in.	9995213
7	Hose, corrugated, 19 mm bushings, 30 in.	9995230
8	Hose, corrugated, 22mm bushings, 32 in (2x)	9995132
9	Hose, corrugated, 22mm bushings, 30 in, pediatric (2x)	9995130
10	Bag, breathing, 2L, adult	9995320
11	Bag, breathing, 0.5L, pediatric	9995305
12	Hose, corrugated, 22mm bushings, 22 in (2x)	9995123
13	Bag, 3L scavenging w/19mm bushing	9995430

SPARE AND REPLACEMENT PARTS (continued)

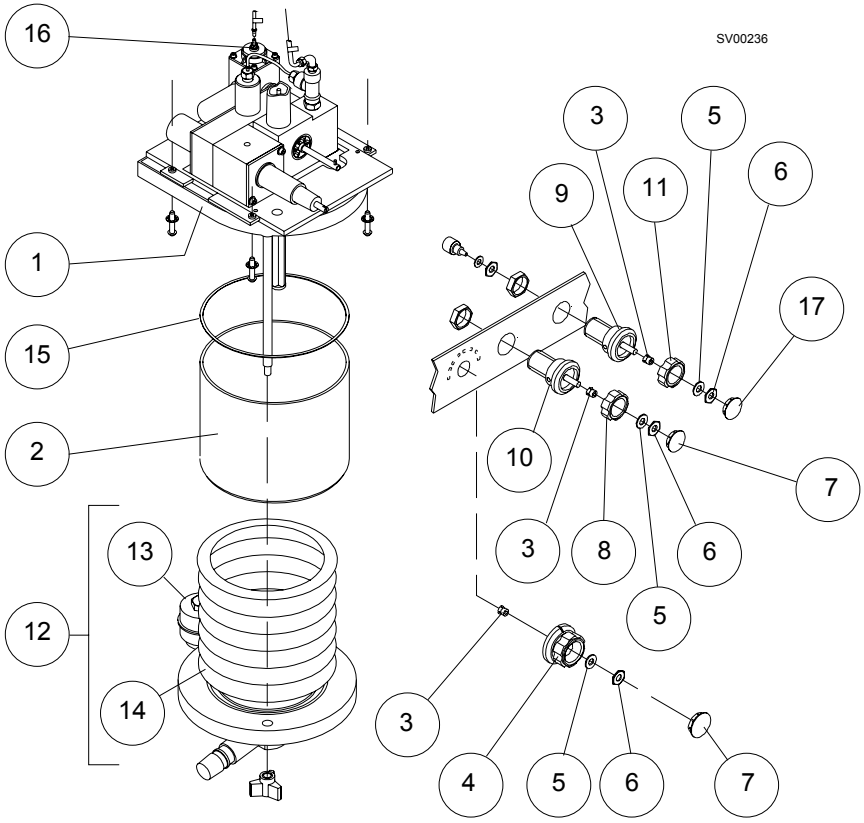


ITEM	DESCRIPTION	PART NUMBER
1	PCB Asm, Personality	4113549
2	Screw, 4-40 x 1.62 in. cap skt hd (4x)	HW01102
3	Lock Washer, #4 int-t (4x)	HW67001
4	PCB Asm, Common Processor	4113595
5	Screw, 8-32 x ⅜ in. btn hd skt (4x)	HW09018
6	Lock Washer, #8 int-t (4x)	HW67011
7	Hose, 0.13 ID, 8 in.	ML08007
	Fitting, 0.13 hose x ⅛ MPT	4102963
	Nut, Panel 9/16 - 18	4108156
	Quick-disconnect Fitting	4108155
8	O_2 Interface Cable Assembly	4113909-001
9	Volume Interface Cable Assembly	4113910-001
10	Cable Assembly, Display Interface	4114288
11	Screw, 6-32 x ¼ in. btn hd skt (2x)	HW09076
12	Lock Washer, #6 split (2x)	HW65001
13	Speaker Mounting Bracket	4113285
	Speaker Assembly (includes wire harness and connector)	4114366
14	Cable Assembly, Serial Port	4113760-001
15	Processor PCB Assembly (ventilation monitor) (later design: replaces Items 1 and 4)	4113780-001


1
SV00233

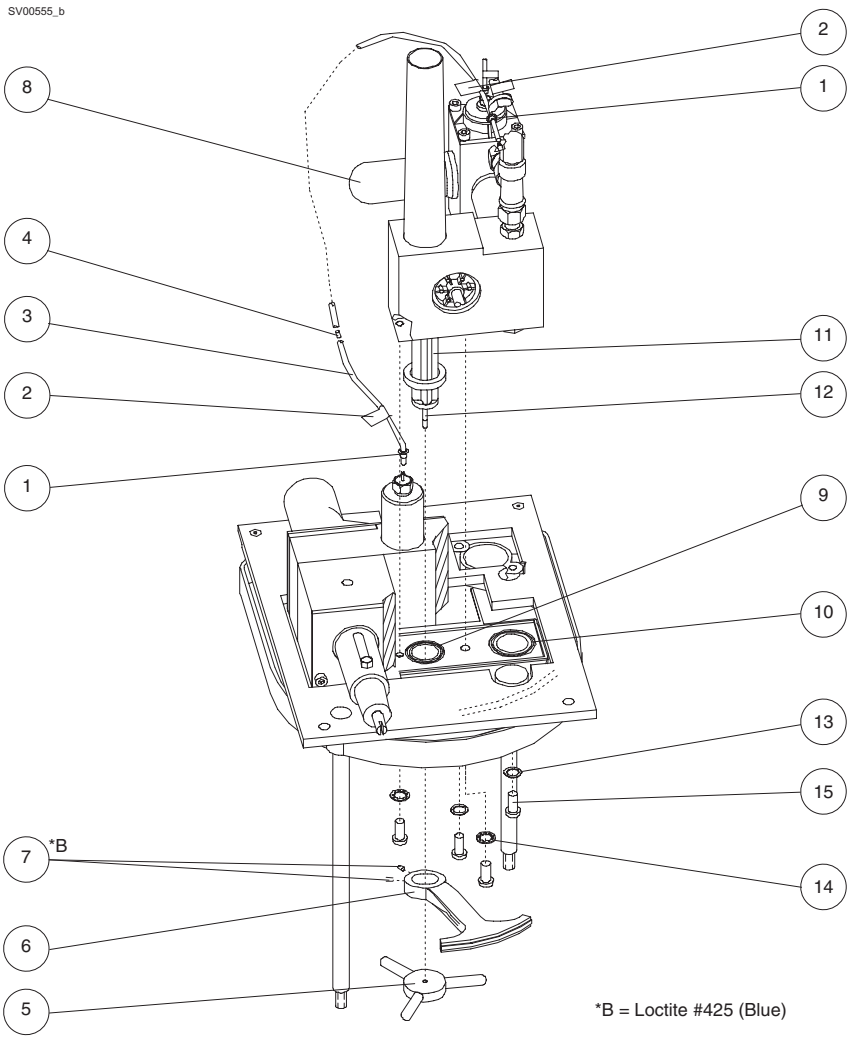
ITEM	DESCRIPTION	PART NUMBER
1	Ventilator Controller Assembly (Bezel Assembly)	4114283
	Mounting hardware for controller assembly:	
	Screw, 8-32 x ⅜ in. cap skt hd (2x)	HW01012
	Lock Washer, #8 split (2x)	HW65011
	Flat Washer, #8 (2x)	HW66002

SPARE AND REPLACEMENT PARTS (continued)



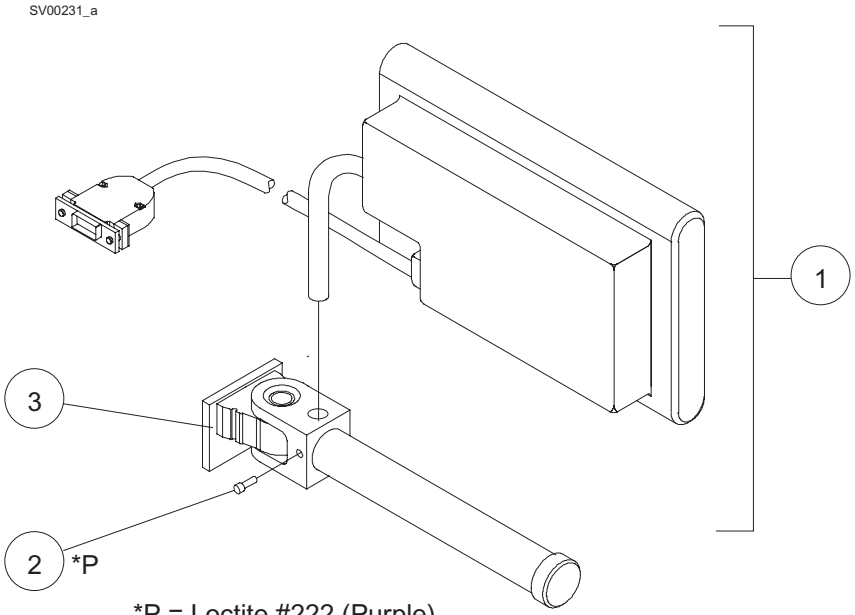
ITEM	DESCRIPTION	PART NUMBER
1	Bellows Valve Assembly	4112272-001
2	Canister	4106948
3	Collet (3x)	4112167
4	Knob, PLC Adj.	4113279
5	Flat Washer, #10 (3x)	HW66003
6	Hex Nut, M5 x 0.5 (3x)	4112066
7	Knob Cover (2x)	4113278-002
8	Knob, Tidal Vol Adj	4113280
9	Housing, switch	4114041
10	Housing, push to turn asm	4112467
11	Knob, Off-On Switch	4113281
12	Bellows Assembly	4114102
13	Relief Valve Assembly	4108050
	Diaphragm Assembly	4110960
14	Urethane (Non-Latex) Bellows Sub-assembly, Adult	4106930-001
	O-ring #217 (neoprene)	4101817
15	O-ring #256, canister gasket	4107018
16	Hose barb fitting, 1/16 ID x 10-32 w/seal	4112707-001
17	Knob Cover	4113278-001

SPARE AND REPLACEMENT PARTS (continued)



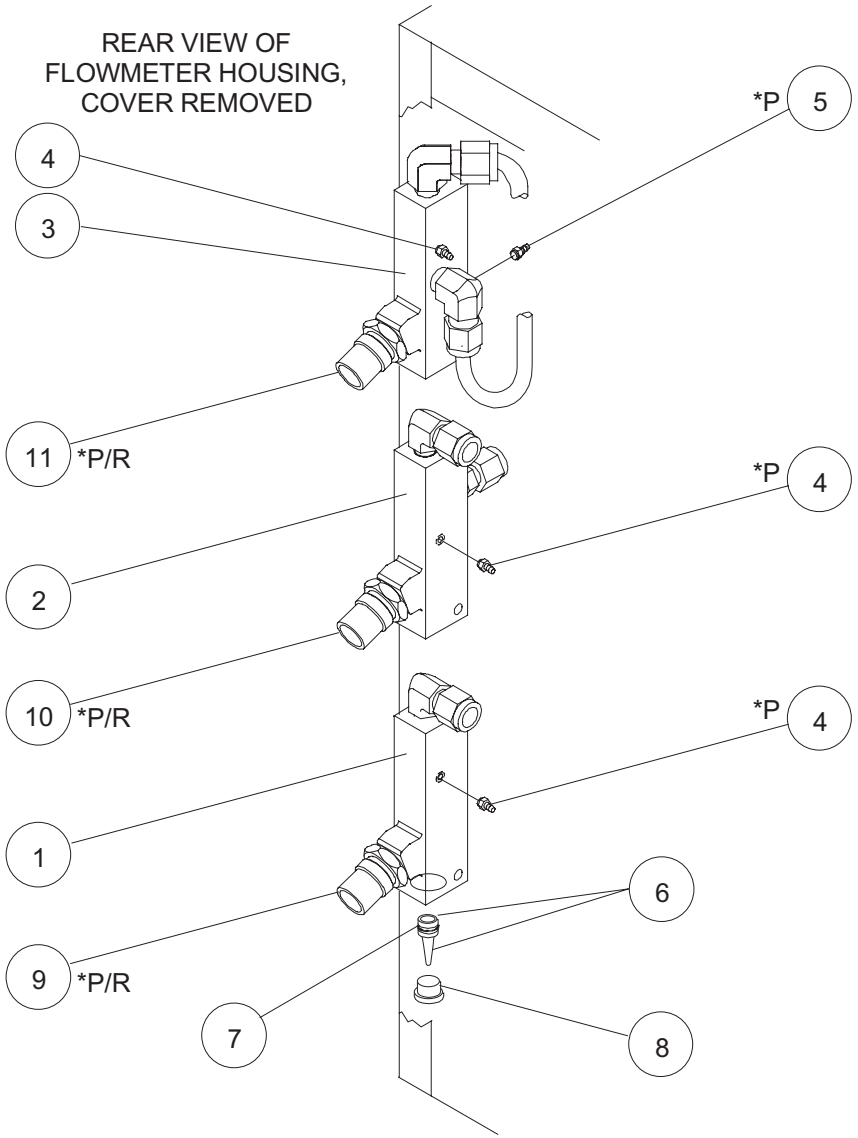
Bellows Valve Assembly details:

1	Press-on Hose Clamp (2x)	4104161
2	Label, O_2 Tubing (2x)	4109871
3	Hose, 0.075 I.D.	ML08003
4	Restrictor	4107639
5	Bellows Top Guide	4110735
6	Volume Indicator	4108276
7	Set Screw, 6-32 x ¼ in. cup point (2x)	HW04003
8	Silencer, pneumatic, 3/8 NPT	4109819
9	O-ring, #19 silicone	4107096
10	O-ring, #22 neoprene	4104595
11	Rod, bellows adjust	4110727
12	Rod	4106418
13	Lock washer, #8 split	HW65001
14	Lock washer, #8 int-t	HW67000
15	Screw, 8-32 x 3/8 in. btn hd skt	HW09008



*P = Loctite #222 (Purple)

ITEM	DESCRIPTION	PART NUMBER
1	Display Assembly with thumbscrew retainers on connector	4114249
	Later design with slide latch retainer on connector	4115756
	(display assemblies include mounting rod)	
Kit to convert display and machine to slide latch arrangement		4116071
2	Screw, 6-32 x ⅝ in., skt hd.	HW01067
3	Joint Assembly and Monitor Support Arm	4114286



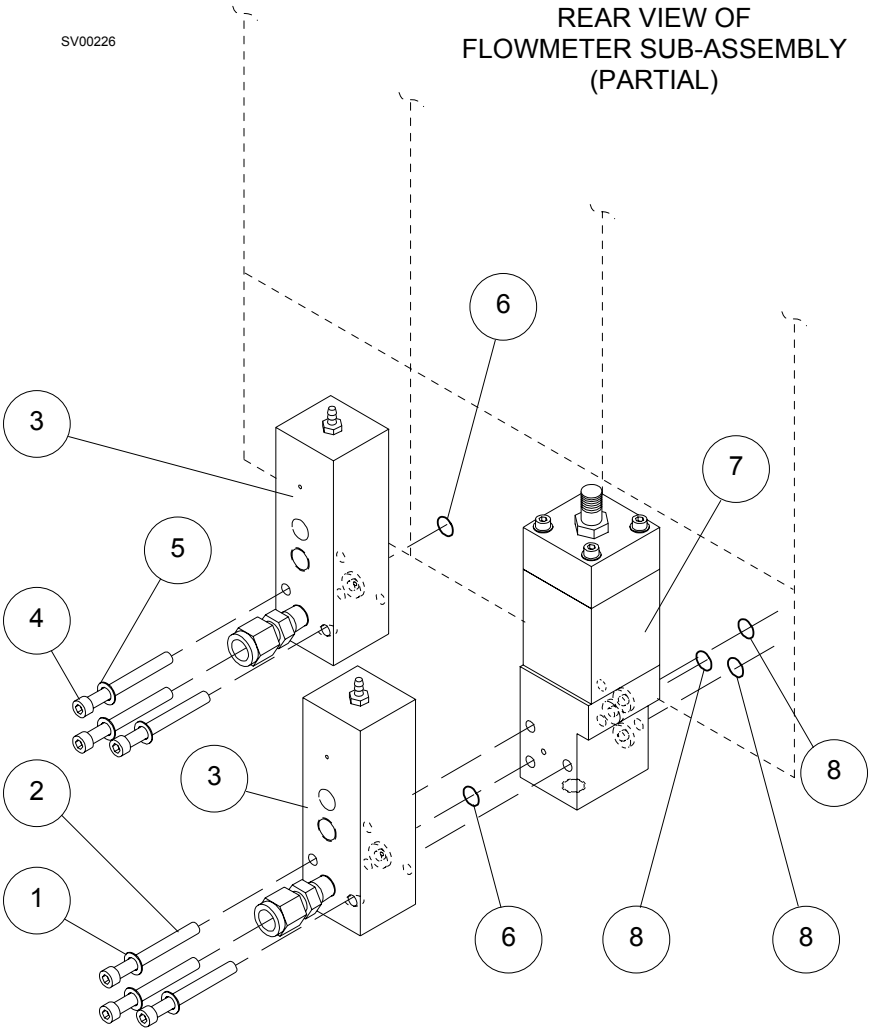
*P = Loctite #222 (Purple)
*P/R = Loctite #747 (Primer) & Loctite #271 (Red)

SV00237_a

ITEM	DESCRIPTION	PART NUMBER
	Pipeline Inlet Assemblies:	
1	N_2O Inlet Manifold (incl. fittings and filter)	4115047
2	Air Inlet Manifold (incl. fittings and filter)	4115045
3	O_2 Inlet Manifold (incl. fittings and filter)	4115046
4	Hose Barb Fitting, 1/16 ID x 10-32 w/ seal	4112707-001
5	Fitting Adapter, hose barb, 0.024 ID x 10-32	4115023
	Typ., all inlet assemblies:	
6	Filter and Connector (assembled, incl. O-ring)	4114345
7	O-ring (neoprene)	4112619-009
8	Plug	4114328
	O-ring for N_2O DISS Nipple	4113494
9	Body, DISS N2O x ⅛ MPT	4111384
10	Body, DISS Air x ⅛ MPT	4102886
11	Body, DISS O2 x ⅛ MPT	4102563

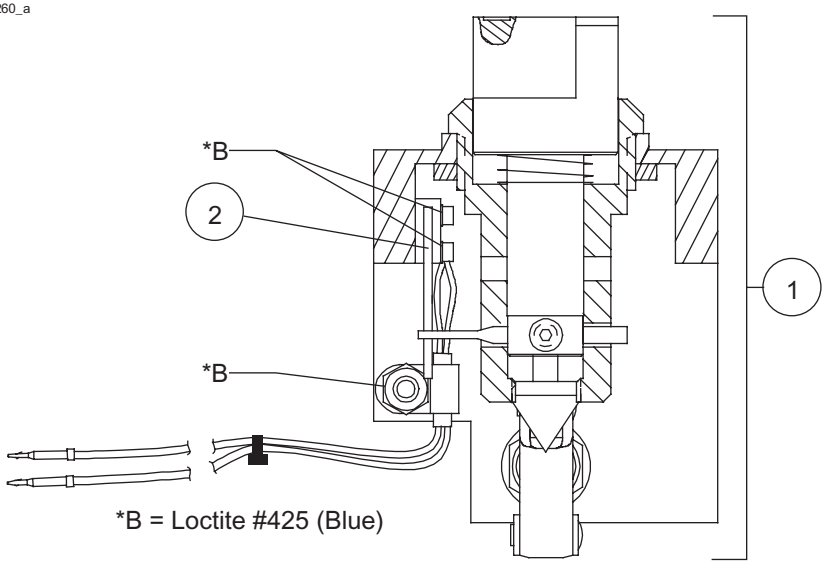
SV00226

REAR VIEW OF
FLOWMETER SUB-ASSEMBLY
(PARTIAL)

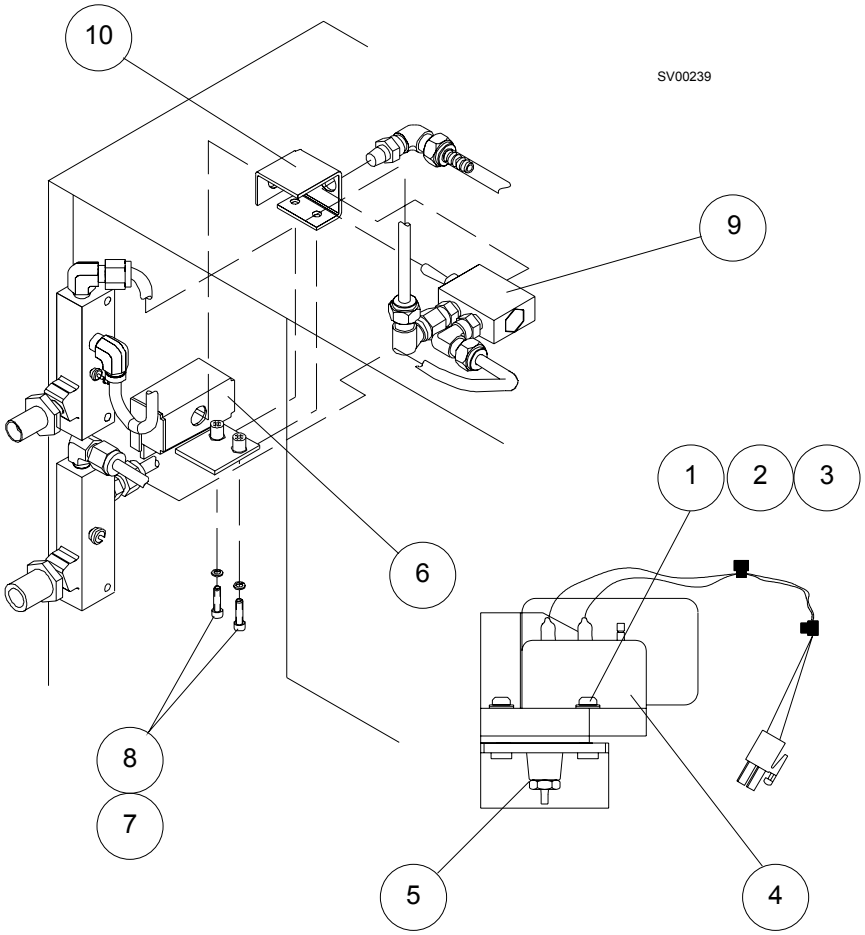


ITEM	DESCRIPTION	PART NUMBER
1	Lock Washer, #8 split (3x)	HW65011
2	Screw, 8-32 x 1⅜ in. cap skt hd (3x)	HW01110
3	OFPD (Failsafe Assembly) (2x)	4114031
4	Screw, 8-32 x 3 in. cap skt hd (3x)	HW01090
5	Lock Washer, #8 split (3x)	HW65011
6	O-ring, #105 (neoprene)	4111893
7	ORC Assembly	4114277-001
8	O-ring, #105 (neoprene)	4111893
	Not shown:	
	Filter	4111805
	O-ring, 0.166 x 0.042 (Buna-N)	4111894

SV00260_a



ITEM	DESCRIPTION	PART NUMBER
1	Main Switch Assembly	4114278
2	Switch Assembly (incl. leaf switch, wire harness & connector)	4114318


10
SV00239
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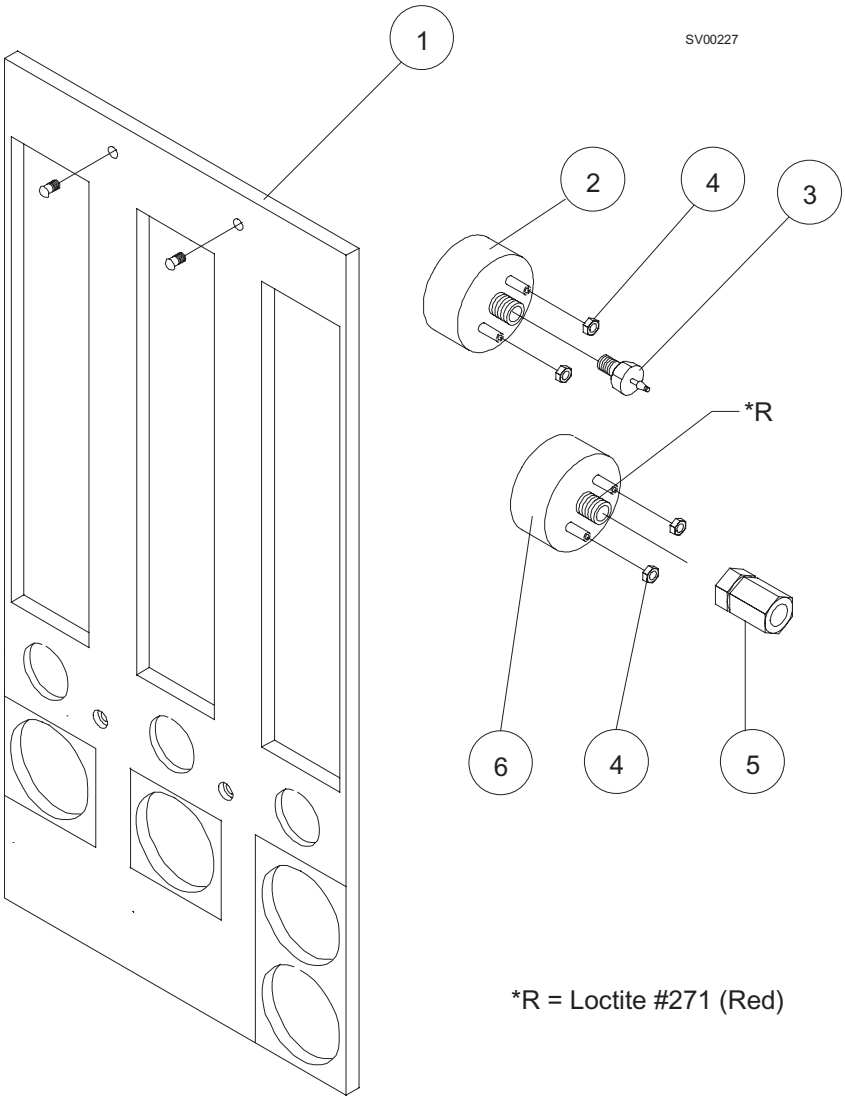
ITEM	DESCRIPTION	PART NUMBER
	O_2 Supply Pressure Switch:	
1	Screw, 2-56 x ⅝ in. btn hd skt (4x)	HW09085
2	Lock Washer, #2 int-t (4x)	HW67012
	Flat Washer, #2 (4x)	HW66009
3	Switch assembly (incl. wire harness)	4114331
4	Nut	(supplied with switch)
	O_2 - Air Switch:	
5	Nut	(supplied with switch)
6	Housing	4114310
7	Screw, 8-32 x 1 in. cap skt hd (2x)	HW01018
8	Lock Washer, #8 split (2x)	HW65011
9	Switch (Valve, 3-way)	4115136

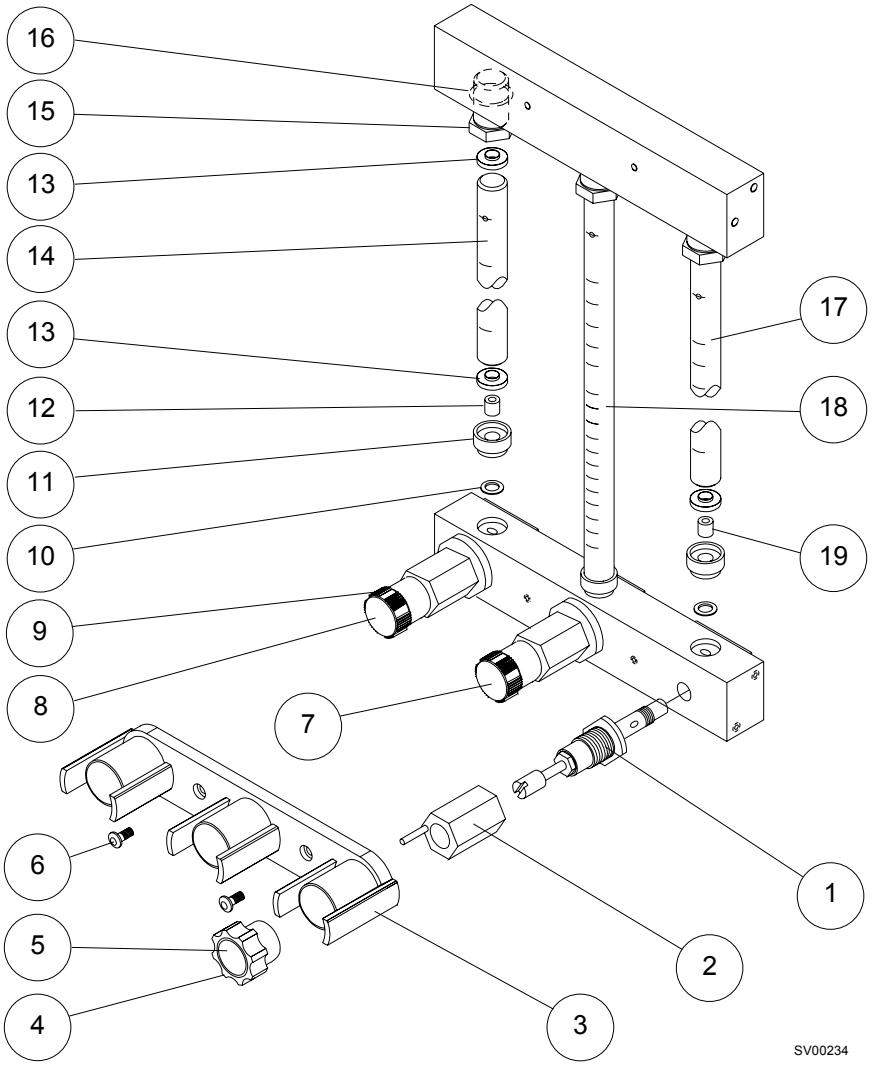
SPARE AND REPLACEMENT PARTS (continued)



*R = Loctite #271 (Red)

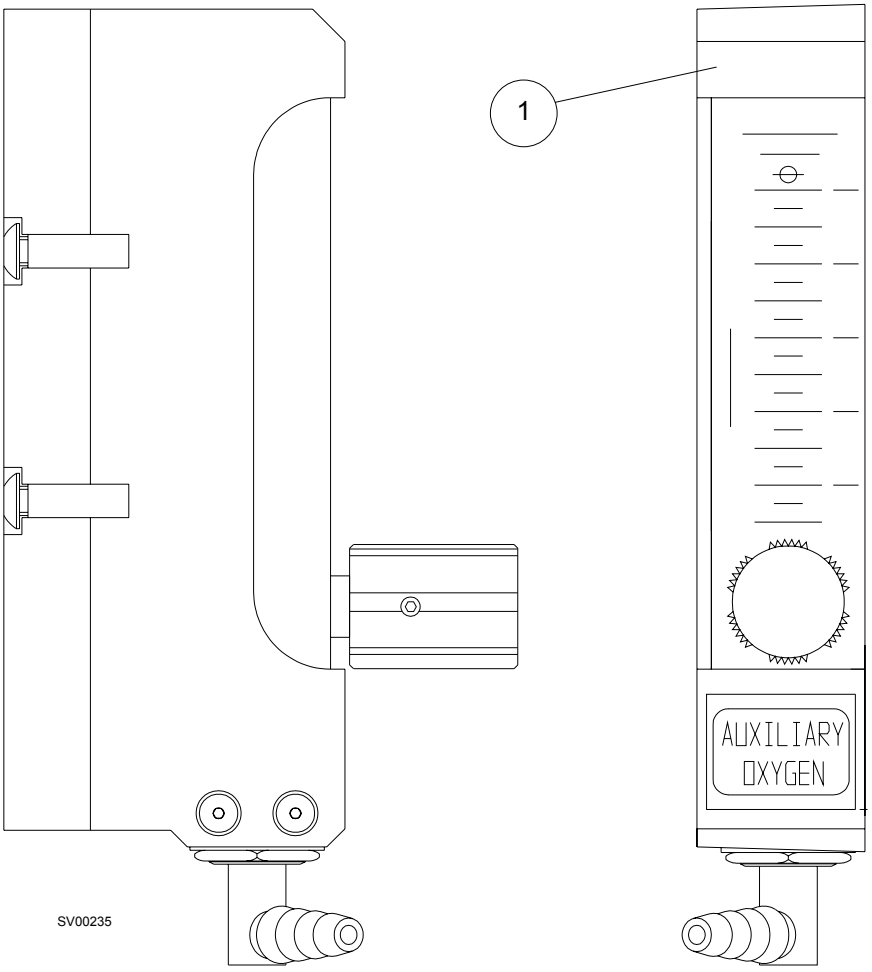
ITEM	DESCRIPTION	PART NUMBER
1	Shield, Flowmeter, 3-Gas NMM	4114291
2	Gauge, 100 psi NMM	4114247-001
3	Hose barb ftg, 1/16 ID x 10-32 w/seal (3x) (pipeline gauges)	4112707-001
4	Kep Nut, (2x per gauge)	HW55003
5	Straight Fitting (cylinder gauge)	4109402
6	Gauge, 3000 psi NMM	4114247-002

SPARE AND REPLACEMENT PARTS (continued)

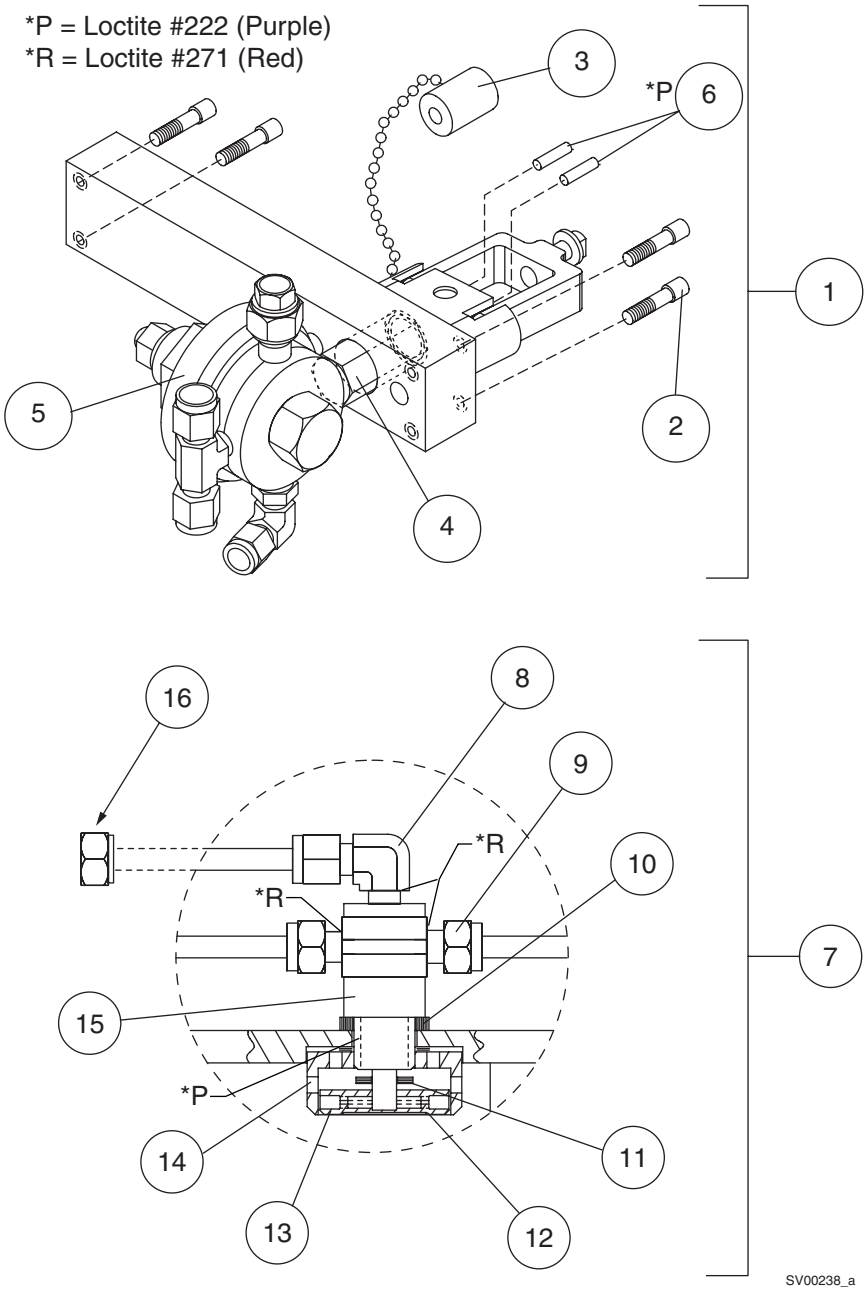


ITEM	DESCRIPTION	PART NUMBER
1	Flow Control Valve (3x)	4114036
2	Stop Pin Nut (3x)	4111892
3	Knob Guard, 3 Gas	4110574
4	Knob, O_2	4103156
5	Label, O_2 Flow Control Knob, Green (USA)	4103178
6	Screw, 6-32 x 7/16 btn hd (2x)	HW09017
7	Label, Air Flow Control Knob, Yellow (USA, Germany)	4103905
8	Label, N_2O Flow Control Knob, Blue (USA, UK, Canada)	4103904
9	Knob, Flow (2x)	4103736
10	O-ring, #010 (neoprene) (2x)	4101872
11	Restrictor Housing (2x)	4103440
12	Restrictor, N_2O, black	4110738-005
13	Gasket and Guide Ring (2x each flow tube)	4102724
14	Flow Tube, N_2O, 0.1 - 8L	4114263
15	Connector (Flow tube retainer) (3x)	4114017
16	O-ring, #109 (EPDM) (3x)	4112628-001
17	Flow Tube, O_2, 0.1 - 8L	4114262
18	Flow Tube, Air, 0.1 - 8L	4114264
19	Restrictor, O_2, red	4110738-003

SPARE AND REPLACEMENT PARTS (continued)



ITEM	DESCRIPTION	PART NUMBER
1	Auxiliary O_2 Flow Meter Assembly	4109310-002
	Mounting hardware:	
	Screw, 10-32 x ½ in. btn hd (2x)	HW09001


*P = Loctite #222 (Purple)
*R = Loctite #271 (Red)
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*R
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*P
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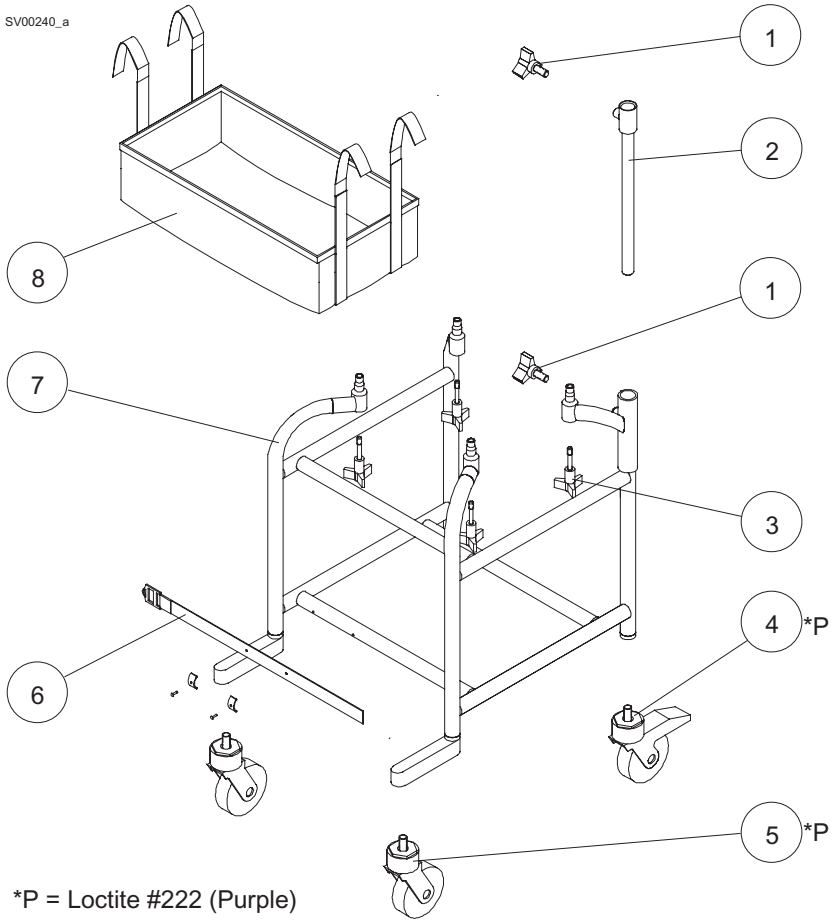
SV00238_a

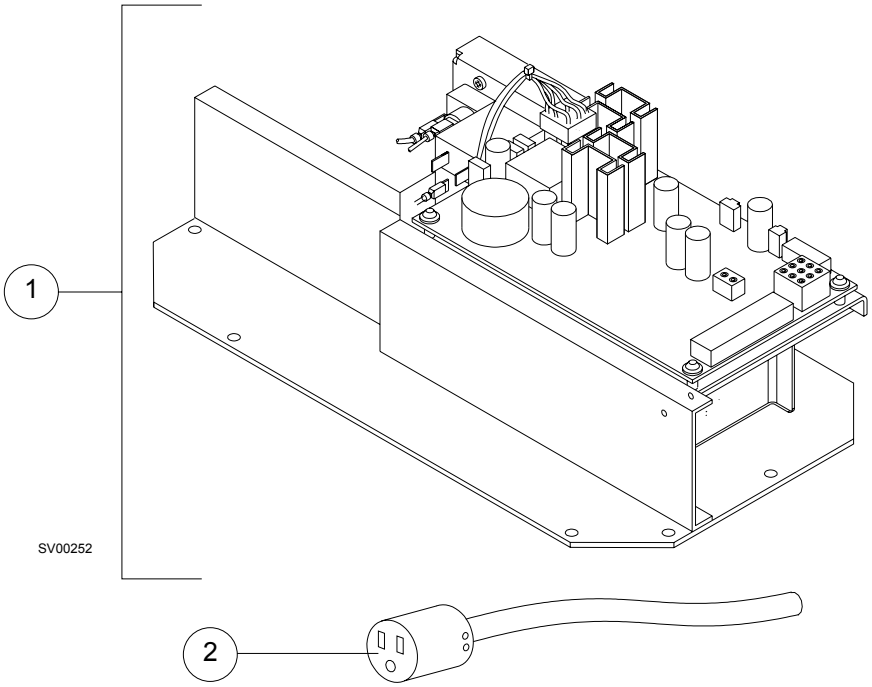
ITEM	DESCRIPTION	PART NUMBER
1.	O_2 Yoke and Regulator Assembly	4114347
2	Screw, 10-32 x ⅞ in. cap skt hd (4x)	HW01076
3	Plug assembly, yoke	4112755-001
4	Check valve assembly	4113932
5	Regulator assembly, O2 pressure	4103590
6	Screw (index pin), sltd, 0.157OD x 6-32 x 0.718 L (2x)	4105929
7	O_2 Flush Valve	
8	L-fitting, 1/4 tube x 1/8 MPT	4109410
9	T-fitting, 1/4 tube x 1/4 tube x 1/8 MPT	4109406
10	Spacer-R unthreaded x 0.170	4110792-090
11	Spacer-R unthreaded x 0.049	4110792-021
12	Set screw, 3-48 x 3/16 in. cup pt	HW04020
13	Button	4103249
14	Knob, O2 Flush	4103248
15	Valve, Clippard 2-way	4103340
16	Constrictor, 0.245 OD x 0.046	4115092

SPARE AND REPLACEMENT PARTS (continued)



*P = Loctite #222 (Purple)

ITEM	DESCRIPTION	PART NUMBER
	Frame Assembly	4114285
1	Wing Screw, ⅜-16 x 1 in. (2x)	1100078
2	Absorber Pole	4114085
3	Wing Screw, 5/16-18 x 2 15/16in. (4x)	4114062-001
4	Caster w/ brake (2x)	4113874-003
5	Caster w/o brake (2x)	4113874-004
6	Strap w/ buckle	4114175
7	Frame	4114061
8	Basket	4114272

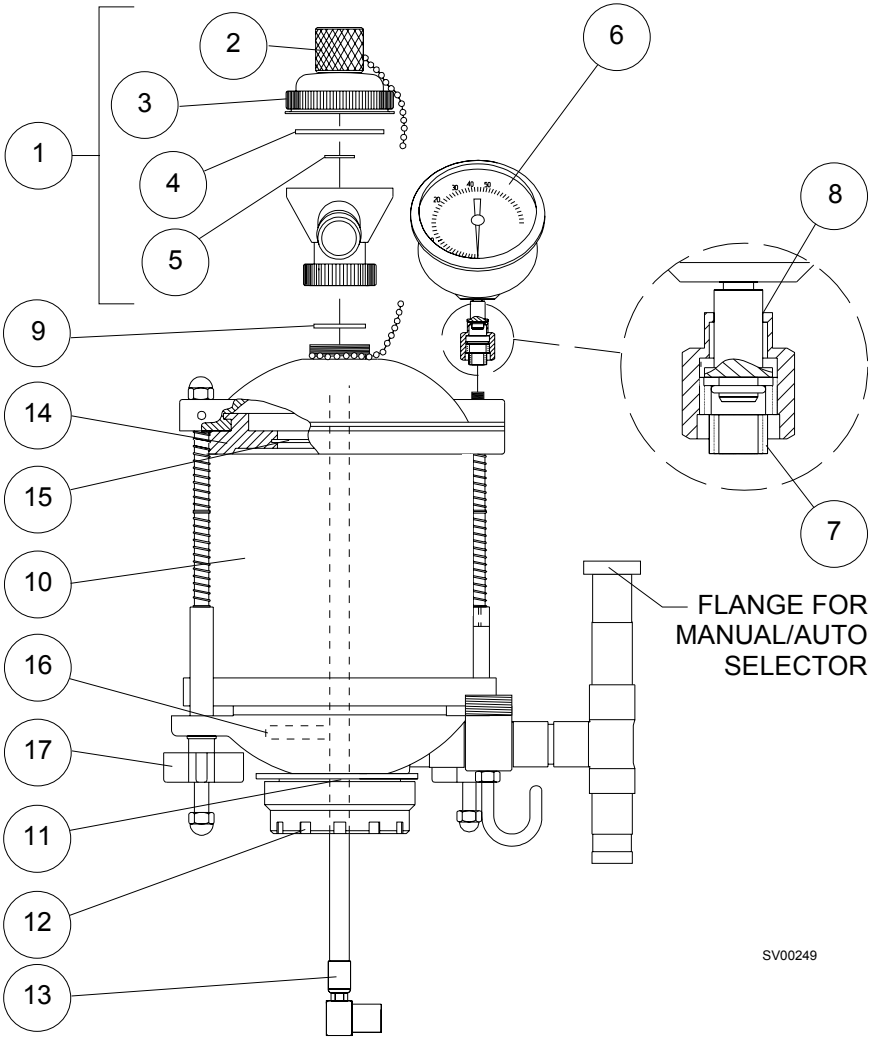

1
SV00252
2

ITEM	DESCRIPTION	PART NUMBER
1	Power Supply Assembly, NMM	4114284
2	Adapter, cable translator	4114359

Electrical items not shown:

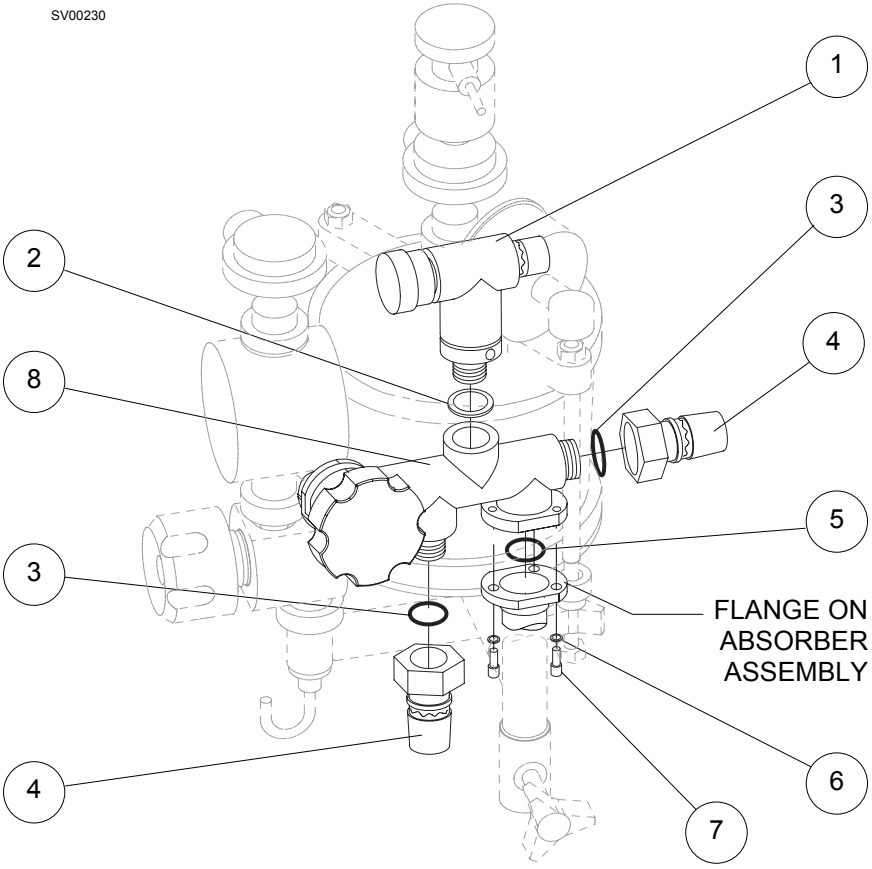
Main Cable Assembly	4114289
Lamp Assembly	4114330

SPARE AND REPLACEMENT PARTS (continued)



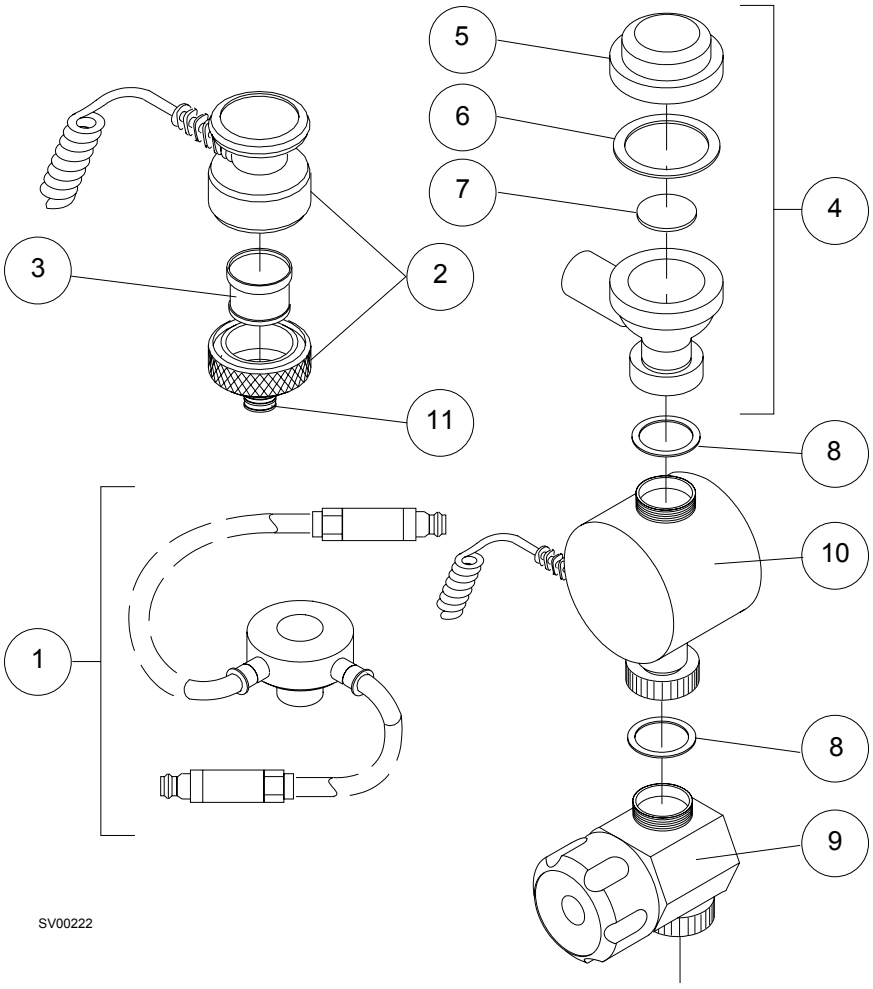
ITEM	DESCRIPTION	PART NUMBER
	Absorber Assembly	4114117
	Manual/Auto Selector Valve is shown on a subsequent page	
	Expiratory Valve, PEEP Valve and Spiromed Sensor are shown on a subsequent page	
1	Inspiratory Valve Assembly w/O_2 sensor mount	4112773-001
2	Plug Assembly, Oxygen Sensor	4106387
3	Dome & Label, Insp. Valve	4108329
4	Gasket, Valve Dome	2109231
5	Disk	M23225
6	Gauge Assembly, (Incl fitting for breathing pressure hose)	4114290
	Replacement Cover	4113387
	Replacement Ring	4113388
7	Gauge Mount Adapter	4114234
8	O-ring, #010 (neoprene)	4101872
9	Gasket, Valve Mount	1101690
10	Canister (Incl lower gasket)	4105851
11	O-ring, #335 (EPDM)	4114167
12	Dust Cup	4114094
13	Fresh Gas Hose	4108577
14	Gasket, canister top	4105848
15	Screen, canister	1100022
16	Gasket, canister bottom	4105849
17	Wing nut (2x)	4114087

SPARE AND REPLACEMENT PARTS (continued)

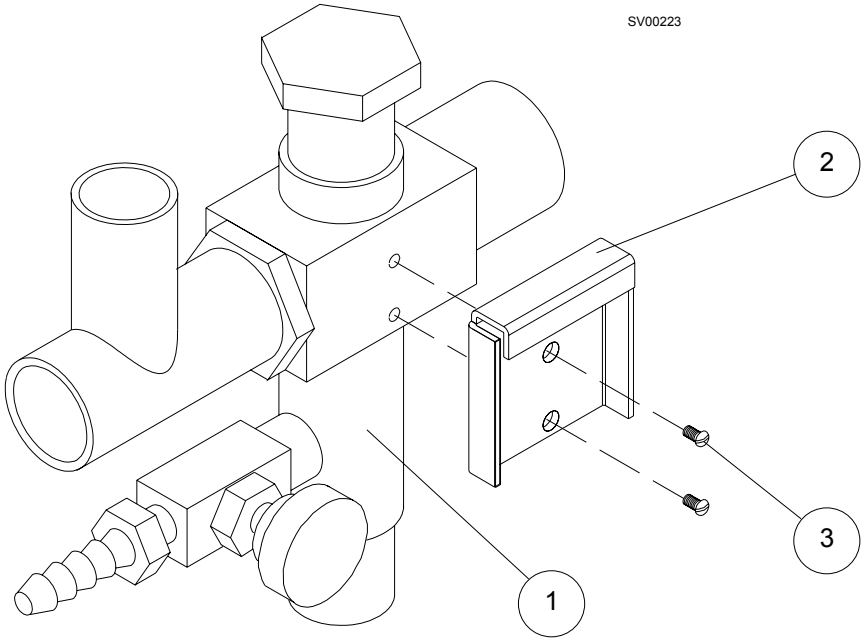


ITEM	DESCRIPTION	PART NUMBER
	Valve, Man/Auto Selector	4114165
1	APL Valve	4104839
2	Fiber Washer	(Supplied with APL Valve)
3	O-Ring, #120 EPDM (2x)	4112629-001
4	Connector, 22mm (2x)	4114093
5	O-Ring, #117 Silicone	4105766
6	Lock Washer, #8 split (3x)	HW65011
7	Screw, Selector Valve Mounting, 8-32 x 7/16 in. Skt Hd Cap (3x)	HW01013
8	Auto-Bag Valve Body	

SPARE AND REPLACEMENT PARTS (continued)



ITEM	DESCRIPTION	PART NUMBER
1	Breathing Pressure Hose Assembly	4114281
2	O_2 Sensor Housing Assembly	4106363
3	O_2 Sensor Capsule (old number: 6803290)	6850645
4	Expiratory Valve Assembly	4112150
5	Dome	2109230
6	Gasket, Valve Dome	2109231
7	Disk	2123249
8	Gasket, Valve Mount (2x)	1101690
9	PEEP Valve Assembly	4114164
10	Spiromed Sensor	4106362
11	O-ring, O2 sensor housing (2x)	4106388


SV00223
2
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1

ITEM	DESCRIPTION	PART NUMBER
1	Scavenger	4114255
2	Mounting Bracket	supplied with scavenger
3	Screw, 6-32 x ¼ in. pan hd (2x)	supplied with scavenger

Items not shown:

Lint Filters (10 pcs.)	1199
Lint Filter Container	14014
Anti-Occlusion Cage	4118551

ITEM	DESCRIPTION	PART NUMBER

Miscellaneous items:

Loctite #271 (Red)	4118558-003
Loctite #425 (Blue)	4118558-008
Loctite #222 (Purple)	4118558-001
Loctite #747 (Primer)	4118558-014

General

Anesthesia machine dimensions (approx.) (W x H x D) 16 x 51 x 21 inches
Anesthesia machine weight (assembled) approx. . . . . .141 lbs
Container 1 dimensions (W x H x D) . . . . . .30 x 16 x 20 inches
Container 1 weight (packed). . . . . .102 lbs
Container 2 dimensions (W x H x D) . . . . . 26½ x 19 x 24 inches
Container 2 weight (packed). . . . . .105 lbs

Environmental

Storage

Temperature. . . . . .-20 to 60° C
Humidity . . . . . .10–90% relative humidity (noncondensing)

Operating

Temperature. . . . . 10 to 35° C
Humidity . . . . . .30–70% relative humidity (noncondensing)

Electrical

Equipment class . . UL 2601 Class 1, Type B, continuous operation, IPXO
Leakage current. . . . . ≤ 300 microamps (UL 2601)
Ground impedance . . . . . ≤ 0.1 ohm (60 Hz source)
Dielectric withstand . . . . . .≥ 1500 VAC (UL 2601)
Chassis resistance (between any metallic point
and ground pin on power cord) . . . . . ≤ 0.1 ohm

Power Supply

Primary input voltage (acceptable range) . . . . 100 to 240 VAC @ 50/60 Hz
Primary input current . . . . . .≤ 2.5 amps @ 50/60 Hz

Backup Battery

Type . . . . . Sealed Lead Acid, 12 VDC, 3.4 Ah
Charging time . . . . . ≤ 12 hours
Reserve power time (from full charge) . . . . . ≥ 90 min

Gas Delivery System

Pipeline inlet connections . . . . . DISS/male (ANSI B57.1-1977)
Pipeline inlet pressure . . . . . 50–55 psi (345–380 kPa) (O_2,N_2O, Air)
Pipeline gauge accuracy . . . . . ±3 psi (0–25 psi)
±2 psi (25–75 psi)
±3 psi (75–100 psi)
Cylinder connection . . . . . Pin-indexed hanger yoke (ANSI/CGA V-1-1987)
Over pressure relief valve . . . . . 95 psi (655 kPa)
Fresh gas common outlet . . . . . 15 mm female
Fresh gas oxygen concentration (ORC) . . . . . 25 ±4%
Oxygen flush flow rate . . . . . 55 (±10) L/min
Minimum oxygen flow (at 50 psi pipeline pressure) . . . . . 150 ±50 mL/min
Low oxygen supply pressure alarm . . . . . 34–40 psi
Cylinder gauge accuracy . . . . . ±90 psi (0–750 psi)
±60 psi (750–2250 psi)
±90 psi (2250–3000 psi)

Cylinder Gas Pressure

Oxygen . . . . . 1900 psi (13100 kPa) E-size cylinder (at 70° F, 21° C)

Flowmeter Accuracy (at 20°C and 760 mmHg)

Oxygen, Nitrous Oxide, Air
Dual Tapered 0-8 L/min . . . . . 0.1 to 0.2 L/min ± 50 mL/min
0.2 to 1.0 L/min ±100 mL/min
1.0 to 8.0 L/min ±5% FS
Oxygen (Auxiliary Oxygen) . . . . . 0–10 L/min ±5% FS

Vaporizer (Dräger-Vapor 2000)

Temperature Range . . . . . 10–40° C
(at normal atmospheric
pressure of 760 mmHg)
Flow Range . . . . . 0.25-15 L/min
Maximum Pressure Load . . . . . 150 mmHg
(above atmospheric)
Maximum Angle of Inclination . . . . . 30° during operation
unlimited during transport (handwheel set to T)
Weight . . . . . Approximately 8.4 kg

The following values refer to individual concentration settings when operated with a continuous flow of air, temperature at 22° C, and normal atmospheric pressure (760 mmHg).

Isoflurane

Adjustment range . . . . . .0.2–6 vol%
Accuracy at flow of 0.25-10 L/min. . . . .± 0.20% concentration (volume) **or** ± 20% rel. (whichever is higher)
Accuracy at flow of 10-15 L/min . . . +0.30/-0.20 concentration (volume) **or** +25%/-20% rel. (whichever is higher)

Halothane

Adjustment range . . . . . .0.2–6 vol%
Accuracy at flow of 0.25-10 L/min. . . . .± 0.20% concentration (volume) **or** ± 20% rel. (whichever is higher)
Accuracy at flow of 10-15 L/min . . . +0.30/-0.20 concentration (volume) **or** +25%/-20% rel. (whichever is higher)

Enflurane

Adjustment range . . . . . .0.2–7 vol%
Accuracy at flow of 0.25-10 L/min. . . . .± 0.25% concentration (volume) **or** ± 20% rel. (whichever is higher)
Accuracy at flow of 10-15 L/min . . . +0.35/-0.25 concentration (volume) **or** +30%/-20% rel. (whichever is higher)

Sevoflurane

Adjustment range . . . . . .0.2–8 vol%
Accuracy at flow of 0.25-10 L/min. . . . .± 0.25% concentration (volume) **or** ± 20% rel. (whichever is higher)
Accuracy at flow of 10-15 L/min . . . +0.35/-0.25 concentration (volume) **or** +30%/-20% rel. (whichever is higher)

Ventilator

Frequency. . . . . 1–99, ±1 BPM (in 1 BPM increments)
I:E ratio . . . . . .*Standard range*: 1:1–1:4.5, ±0.1 (in increments of 0.5); *Extended range*: 4:1, 3:1, 2:1
Inspiratory flow . . . . . .10–100 L/min (uncalibrated)
Tidal volume . . . . . .50–1500 mL, ±100 mL
Pressure limit control adjustment range . . . . . 15–120 cmH_2O

Absorber System

Inspiratory Valve

Mounting ring nut size. . . . . M35 x 1
Hose terminal . . . . . 22 mm male

Expiratory Valve

Mounting ring nut size. . . . . M33 x 1
Hose terminal . . . . . 22 mm male

PEEP Valve

Range . . . . . approx. 2–15 cmH_2O (continuously adjustable)

Breathing System Pressure Gauge

Range . . . . . -20 to +80 cmH_2O
Smallest scale division . . . . . 2 cmH_2O
Nominal accuracy . . . . . -20 to +5 cmH_2O: 3% FS
+5 to +55 cmH_2O: 2% FS
+55 to +80 cmH_2O: 3% FS
Mounting ring nut size. . . . . 1 1/8 x 18
APL ValveNominal low flow resistance . . . . . 2 cmH_2O at 8 L/min
Hose terminal . . . . . 19 mm male
Breathing Bag TerminalBag terminal . . . . . 22 mm male

Oxygen Monitoring

Range . . . . . 10–100 vol % O_2
Resolution . . . . . 1 vol % O_2
Accuracy . . . . . ±3 vol % O_2
(When calibrated within 18 hours, and
constant temperature and pressure)

Response time . . . . . $\leq$ 25 sec (T90)Zero drift_ 0.1 vol % O_2/month
Span drift . . . . . $\leq$ 1 vol % O_2/8 hours
Temperature error. . . . . $\leq$ ± 3% of reading (15° to 40° C)
Sensor service life . . . . . $\geq$ 8 months at 25° C,
50% relative humidity, 50% O_2
gas mixture (or $\geq$ 5000% hour CO_2)

Breathing Pressure Monitoring

Numeric display range . . . . . -10 to 125 cmH_2O
Resolution . . . . . 1 cmH_2O
Accuracy . . . . . ±3 cmH_2O or ±10% of reading, whichever is greater
Waveform display range - full . . . . . 0–100 cmH_2O
Waveform resolution . . . . . 1 cmH_2O
Waveform accuracy . . . . . ±3 cmH_2O or ±10% of reading, whichever is greater
Waveform display scales . . . . . 0–20, 0–50, 0–100 cmH_2O

Respiratory Volume Monitoring

Minute Volume

Display Range . . . . . 0.2 to 50.0 L
Resolution . . . . . 0.1 L
Accuracy . . . . . ≤ +10% or 0.1 L, whichever is greater

Tidal Volume

Display Range . . . . . 0.05 to 20.1 L
NOTE: The standard bellows will deliver up to 1.5 L

Resolution . . . . . 0.01 L
Accuracy . . . . . ≤ ±10% or 0.01 L, whichever is greater
Volume Apnea Threshold . . . . . 0.05 L

Respiratory Rate

Numeric display range . . . . . 2–99 BPM
Resolution . . . . . 1 BPM
Accuracy . . . . . ≤ ±10% or ±1 BPM, whichever is greater

Serial Interface

Serial Port

Type RS-232/422
Baud Rate . . . . . 300 to 38400
Parity . . . . . Odd, Even, or None
Data Bits . . . . . 7 or 8
Stop Bits . . . . . 1 or 2
Protocol . . . . . Vitalink

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Dräger medical

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Narkomed M Service Manual

Rev. K summary of changes

Page	Description
Cover	Changed Rev and date
6-1	Changed P/N of PMC form
8-43	Changed P/N of item #5

Rev. J summary of changes

Cover	Changed Rev and date
6-1	Changed P/N of Test Lung
6-7	Changed P/N of Test Lung
6-32	Corrected typo in all steps within 6.12

Rev. H summary of changes

There were no changes in this revision. This revision was skipped to synchronize the representative documentation drawing with the actual revision of the manual.

Rev. G summary of changes

Page	Description
Cover	Changed Rev and date
8-1	Updated TOC
8-18	Added Loctite reference
8-20	Added Loctite reference
8-22	Added Loctite reference
8-26	Added Loctite reference
8-30	Added Loctite reference
8-36	Added Loctite reference
8-38	Added Loctite reference
8-49	Added “Items Not Shown”
8-50	Added new page of Miscellaneous Items

Rev. E summary of changes

Page	Description
6-35	Revised ORC test
8-1	Revised local TOC for bellows valve asm details
8-18, 8-19	Added bellows valve assembly details
8-20 thru 8-47	Page numbers revised
Added 8-48, 8-49	Continued page number revisions